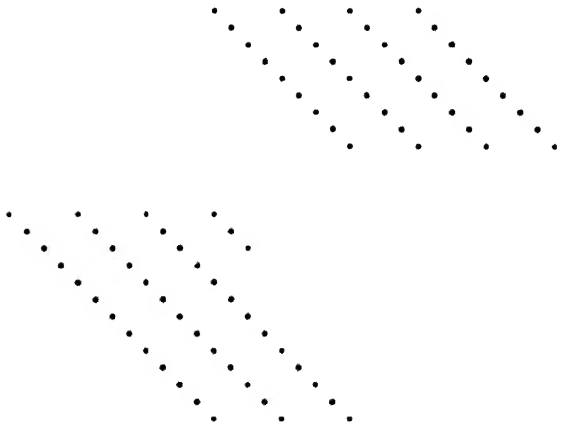
VIPER™

Half-high, Intelligent 5 1/4"
Streaming Cartridge Tape Drive

Product Manual
SCSI Models 2060S and 2150S



ARCHIVE®
CORPORATION

VIPER™

Half-high, Intelligent 5 1/4"
Streaming Cartridge Tape Drive

Product Manual
SCSI Models 2060S and 2150S

PART NO. 21391-001

ARCHIVE® CORPORATION

1650 Sunflower Avenue
Costa Mesa, CA 92626
(714) 641-0279/Telex: 4722063

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Preface

The Viper is Archive's high performance 5 1/4" tape drive. The Viper contains enhanced mechanics and performance features, including an embedded controller in a small (half-high) package.

This document contains a detailed description of the Viper tape drive. The document is intended for individuals who are familiar with tape drive technology. It provides the technical information required to integrate the Viper and a user host system.

In this document:

Chapter 1, *Overview*, briefly describes the Viper Tape Drive, its models and features.

Chapter 2, *Installation*, contains the Viper chassis dimensions and description and the information required to install the appropriate jumper clips.

Chapter 3, *Physical Descriptions*, contains the physical, environmental, power, data and tape handling, and tape cartridge specification tables. It describes the Viper in more detail, breaking the system into its mechanical and electrical assemblies. The tape cartridge is also described.

Chapter 4, *Functional Descriptions*, highlights special features of the Viper along with the standard operational features of Archive streaming tape drives.

Chapter 5, *Hardware Interface*, describes the communications hardware signals and pinouts.

Chapter 6, *SCSI Interface*, describes the messages, status, commands and data exchanged between the Viper and its hosts--including formats, implementation, and configuration information.

Chapter 7, *Reliability and Maintenance*, gives the reliability specifications of the Viper and preventive maintenance information.

Appendix A, *Archive Part Numbers*, lists the part numbers utilized with Viper SCSI tape drives.

Viper Tape Drive

Chapter 1
OVERVIEW

THE VIPER TAPE DRIVE

The Viper is a 1/4 inch cartridge streaming tape drive plus intelligent controller in a 5 1/4" half-high form factor. It is the ideal solution to the backup requirements of high capacity Winchester disk drives. Other applications include software distribution, transaction logging, data collection, data exchange, and program loading.

Configurations

Viper's embedded controller is available with a SCSI (Small Computer System Interface)[1] interface to the host computer system in both 60 megabyte and 150 megabyte capacity models.

Both models may be ordered with or without the SCSI terminating resistors installed.

MODEL NO.	INTERFACE	STORAGE CAPACITY
2060S	SCSI	60 megabytes
2150S	SCSI	150 megabytes

MODEL NO.	WITH TERMINATORS	WITHOUT TERMINATORS
2060S	P/N 21153-xxx	P/N 21068-xxx
2150S	P/N 21251-xxx	P/N 21249-xxx

Features

Advanced LSI circuitry and surface-mount technology have resulted in the reduced package size, low power consumption, and high data reliability of the Viper. Dependability is further ensured by the Viper's sturdy aluminum die-cast chassis, a reliable DC brushless motor, and a tape-loading mechanism that is easy to use and has few moving parts. The following are some of the Viper's many features.

[1] Additional host interfaces are available with Viper.

- Half-high -- fits in 5-1/4-inch, half-high form factor.
- 60, 125 or 150 megabyte capacity.
- Backward compatibility with existing QIC-24 and QIC-120 format tape libraries.
- High data transfer rates of 112.5 Kbytes/second (Model 2150S) and 90 Kbytes/second (Model 2060S).
- Large 64 kilobyte RAM buffer for good streaming performance.
- SCSI burst data rates up to 1.8 megabytes/second.
- Selectable SCSI disconnect length for good bus utilization.
- High speed direct block access capability.
- High speed end of recorded data seeking.
- Edge-of-tape seek eliminates cartridge tolerance variations.
- Reference burst used for accurate data tracking.
- Off-track stepping for reliable data recovery.
- Low power requirements.
- Resident diagnostics allow tests to be performed under control of a built-in serial port.
- Advanced low-noise read/write for excellent data reliability.
- Microprocessor-controlled read threshold, and write current control.
- Write precompensation enhances data reliability and interchange. (Model 2150S only).

Chapter 2

INSTALLATION

COMPUTER SYSTEMS

The Viper tape drive is designed for installation in the same space as a half-high 5 1/4 inch floppy disk in a variety of computer systems.

Free air flow is required for the Viper tape drive to prevent the ambient temperature from rising above 45 degrees C (113 degrees F) under normal operating conditions. Otherwise, forced-air cooling must be supplied to achieve the operating temperature requirements. Refer to Chapter 3 - Environmental Specifications.

CAUTIONS

The following recommendations will facilitate successful installation of your Viper tape drive and help ensure its continued reliable operation.

CAUTION: Static electricity can damage the Viper tape drive. Do not remove the tape drive from the anti-static packaging material until you are ready to install the drive in the computer system.

Before handling the tape drive, discharge any static electricity that may have built up on your body. You can do this by placing your hand on a metal part of your system chassis or a grounded metal surface.

CAUTION: Failure to clean the read/write head at the recommended intervals can result in excessive data errors. Refer to Chapter 7 - Reliability and Maintenance.

CAUTION: To insure reliable operation, power to the drive must be maintained within these limits:

+ 5 Volts, $\pm$5%
+12 Volts, $\pm$10%.

The voltages should be measured at the drive.

RECEIVING AND INSPECTION

Unpacking

To unpack the equipment, place the container(s) on a flat, stable surface. Carefully remove the equipment from the container. If practical, save the container and packing materials for any future reshipment.

Inspection

After unpacking the carton, verify the contents and make sure the contents are undamaged.

Despite the precautions taken to assure that you receive a quality product, damage may still result from careless handling of the carton.

If your carton and/or the contents are damaged, make note of the damages. Look for dents, scratches, broken parts, etc. Notify the shipper or your distributor immediately should damage be apparent.

Handling

Industry standard procedures for handling of electronic equipment are sufficient to ensure the equipment is not subjected to physical shock or damage. Since the unit contains exposed components, proper care should be taken to ensure their protection against physical damage and damage caused by electrostatic discharge induced through handling. Observe the recommendations in section "Cautions" at the beginning of this chapter.

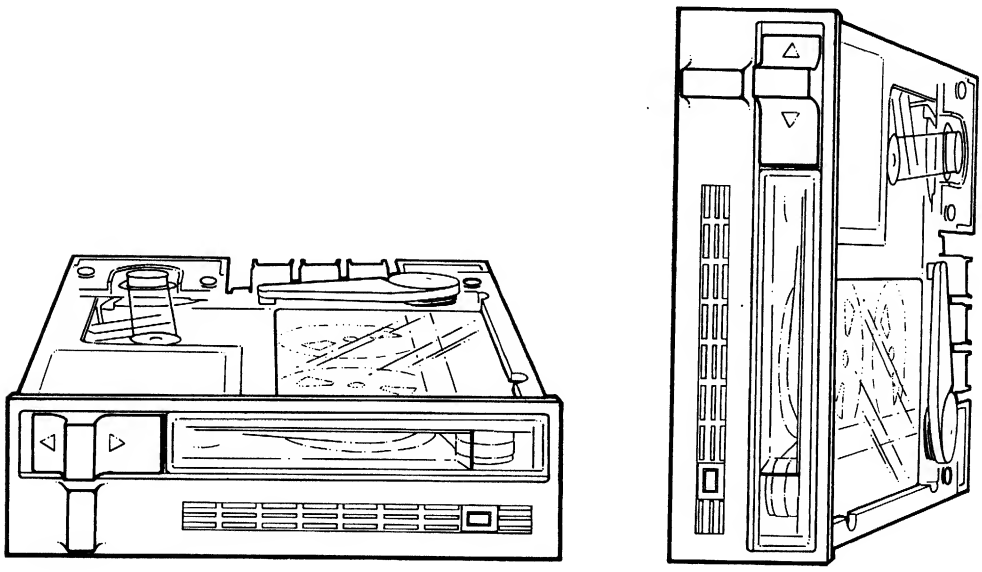
EXTERNAL DESCRIPTIONS

Dimensions

DIMENSION[1]	MEASUREMENT
Height	1.625 in. (4.126 cm)
Width	5.75 in. (14.605 cm)
Depth	8.0 in. (20.32 cm)
Weight	3.0 lbs. (1.36 kg)

Mounting Holes

The Viper tape drive may be mounted horizontally as shown in Figure 1, or vertically. When vertical mounting is desired, the preferred position is with the head loading lever at the top as shown.



HORIZONTAL POSITION

VERTICAL POSITION

Figure 1. Mounting Positions

[1] Excluding front bezel.

Eight 6-32 mounting holes are provided in the drive chassis—four on the bottom and two in each side of the frame (Figure 2). The Viper should be secured in such a way as to not apply excessive stress to the chassis.

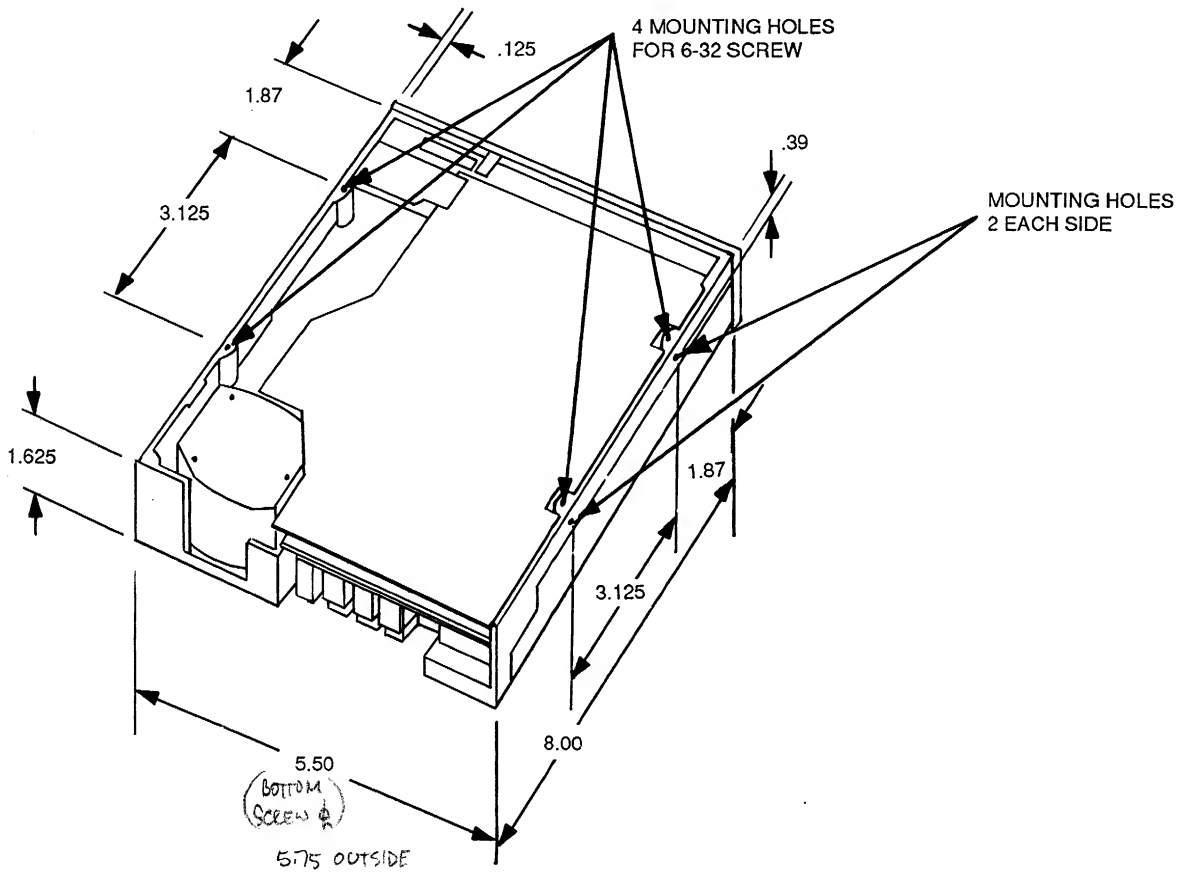


Figure 2. Mounting Hole Locations

Host Interface Connector

SCSI control signals are transmitted to and from the Viper via the host interface connector (Figure 3). Connector pin assignments are listed in Chapter 5 "Pin Assignments and Descriptions".

The recommended mating connector is Burndy FRE-50BF-12, Burndy FRE-50BF-1, or KEL-AM RFM-2852-0, 50-pin connector.

Power Connector

The power connector is located at the upper left on the rear of the Viper assembly (Figure 3). There are four pins, with pin 1 on the left-hand side as you view the Viper from the rear.

The Viper DC power connector is an AMP 641737-1. The mating connector requires an AMP 1-480424-0 housing with AMP 60617-1 pins (or equivalent).

The power connector pin assignments are:

Pin 1	+12 VDC
Pin 2	+12 Return
Pin 3	+5 Return
Pin 4	+5 VDC

Terminating Resistors

The SCSI bus must be terminated at both ends.

If the Viper tape drive is to be the last on the system's daisy chain, it will be necessary that three terminating resistors be installed in the Viper drive. The resistors can be factory installed. (See Chapter 1 "Configurations".)

Figure 3 shows terminating resistor locations on the rear of the Viper assembly. PIN 1 is flagged on the terminating resistors. (Part Number for Archive terminating resistors is in Appendix A.)

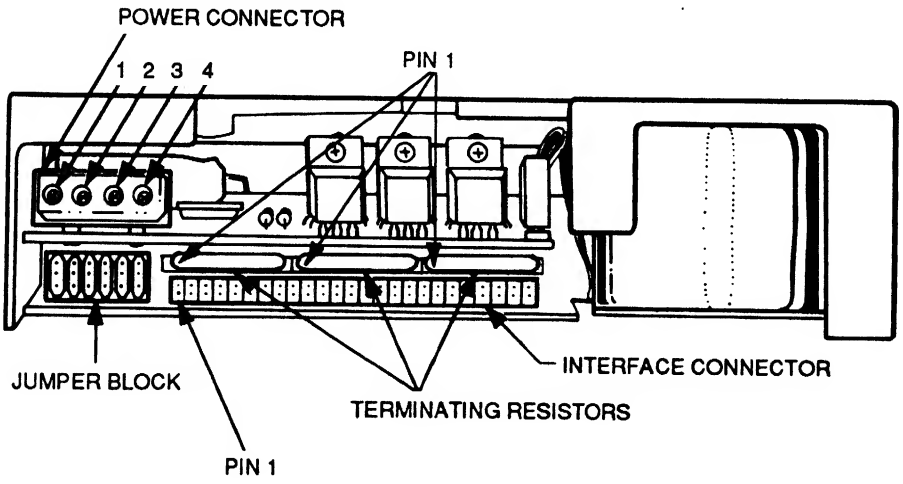


Figure 3. Viper Rear View

Jumper Configuration

The configuration jumper block on the rear assembly provides for 9 connector pairs arranged in three vertical columns of three pairs each (Figure 4). Each jumper clip selects a given pair. (Part Number for Archive jumper clips is in Appendix A.)

The DIAG jumper places the drive in diagnostic mode. When the DIAG jumper is present, the interpretation of the remaining jumper pairs differs from their interpretation in operational mode.

In operational mode (diagnostic jumper removed) the jumper pairs are used to specify the following configuration data:

- parity check enable/disable
- one of eight available disconnect (transfer) sizes
- the Viper controller's bus ID.

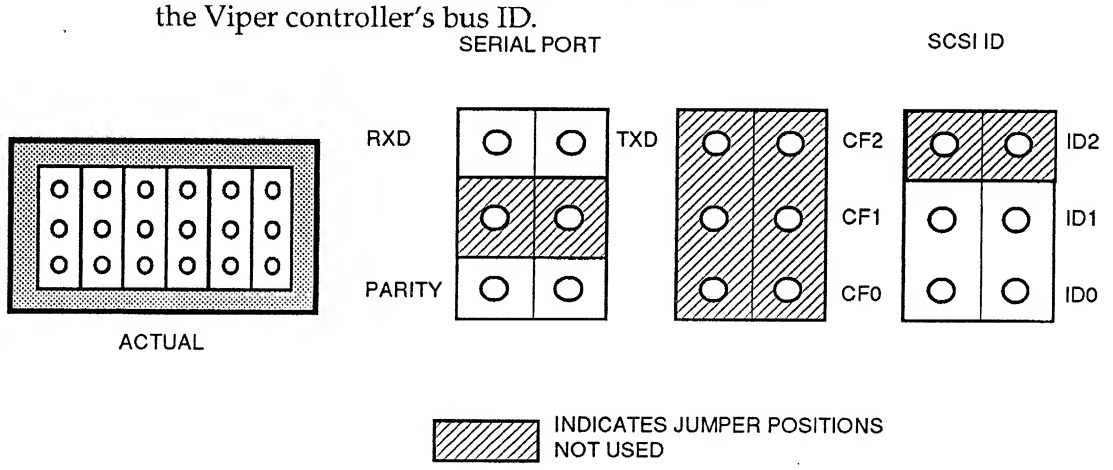


Figure 4. Configuration Jumper Block

PARITY: A single jumper pair is used to specify parity enable/disable. When the pair is connected via a jumper clip, parity checking will be enabled.

DISCONNECT SIZE: The three jumper pairs in column two are used to specify the 3-bit code required to select disconnect size. (Jumper in sets bit to 1.) The top pair rep-

CODE	DISCONNECT SIZE
0H	2K
1H	4K
2H	6K
3H	8K (minimum requirement for COPY command)
4H	12K
5H	16K (factory installed)
6H	24K
7H	32K

Disconnect size represents the maximum number of bytes that can be transferred over the bus during a single Data Phase. Disconnect size is a system performance determinant and can have a significant effect on overall system performance in configurations where more than two SCSI devices must arbitrate for bus time. Since all but the currently communicating SCSI device pair (that is, the current target and the initiator) must wait for the bus in order to proceed with data transfers, disconnect size should be set to permit bus arbitration to occur at shorter intervals. This will help optimize the amount of independent ("off bus") processing that multiple devices can perform in parallel. When the disconnect size is unnecessarily short, productive processing time is sacrificed to the overhead associated with bus arbitration. The optimum setting of disconnect size is a function of both the number of devices that share the bus and the speed at which they can independently process bursts of data.

CONTROLLER I.D.: The three jumper pairs in column three are used to specify the 3-bit Controller I.D. (Jumper in sets bit to 1.) The top pair represents the Most Significant Bit. Note that the I.D. determines the priority of the controller during the bus Arbitration Phase, with value zero representing the lowest priority. Value 7 is always dedicated to the initiator and should never be specified as the Viper controller I.D. In multi-user/multi-initiator systems (where more than two SCSI devices, including the host, are connected to the bus), each device must have a unique I.D. and initiators should have the priority I.D.s.

Chapter 3
PHYSICAL DESCRIPTIONS

SPECIFICATIONS

Environmental

REQUIREMENT	SPECIFICATION
Operational Temperature	+ 5 to 45 degrees C (+41 to +113 degrees F)
Storage Temperature	-30 to +60 degrees C (-22 to +140 degrees F)
Relative Humidity	20 to 80%
Max Wet Bulb Temperature	26 degrees C (79 degrees F)
Altitude	-1,000 to +15,000 ft.

Power

REQUIREMENT	+12V	+5
Tolerance (incl. max. ripple of 200 mV)	±10%	±5%
Standby Current	0.2 amps nom.	0.45 amps nom.
Operational Current	0.8 amps nom. 1.5 amps max.	0.5 amps nom. 0.7 amps max.
Tape Start Surge (up to 300 msec.)	2.5 amps max.	
Power Dissipation (operational)	20 watts typ. 35 watts max.	

Data and Tape Handling

FEATURE	SPECIFICATION	
	2060S	2150S
Capacity[1] (formatted)	60 megabytes	150 megabytes
Track Format	9-Track Serpentine	18- or 15-Track Serpentine
Flux Density	10,000 frpi	12,500 frpi
Data Density	8000 bpi	10,000 bpi
Avg. Transfer Rate	90 kB/sec	112.5 kB/sec
Burst Transfer Rate, max.	1.8 MB/sec	1.8 MB/sec
Recording Format	QIC-24	QIC-150 or QIC-120
Read compatibility	QIC-24	QIC-24, QIC-120 or QIC-150
Data Buffer Size	64 kilobytes	
Tape Speed	90 ips	
Speed Variations	Short term ±7% Long term ±4%	
Start/Stop Time	300 milliseconds max.	
Head Configuration	Two track read while write (1 track in each direction) with separate full width erase.	
Recording Code	GCR (0,2) Run Length Limited	

[1] Using 600-ft. tape cartridge.

Tape Cartridges

Part Numbers for Archive tape cartridges are listed in Appendix A.

TAPE SPEC.	QUALIFIED TAPE	FUNCTION
ANSI X3B5/85-138 ANSI BSR X3.127	3M DC600A 3M DC300XLP	Read/Write (QIC-24) Read/write (QIC-24)

Unrecorded cartridge specifications for Viper 2060S

TAPE SPEC.	QUALIFIED TAPE	FUNCTION
ANSI X3B5/87-165	DC600XTD	Read/Write (QIC-150) Read/Write (QIC-120) Read only (QIC-24)
ANSI X3B5/85-138	3M DC600A	Read/Write (QIC-120) Read only (QIC-24)
ANSI BSR X3.127	3M DC300XLP	Read only (QIC-24)

Unrecorded cartridge specifications for Viper 2150S

Viper Description

The Viper consists of multiple mechanical assemblies plus a front bezel and two electrical assemblies (PCB's). All are assembled in a half-high, 5 1/4-inch drive chassis.

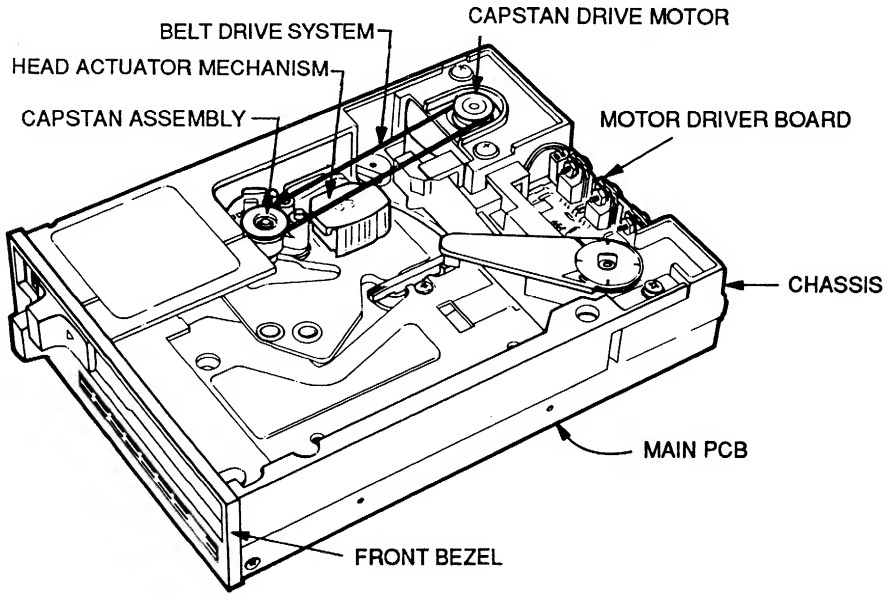


Figure 5. Viper Components (Drive Top View)

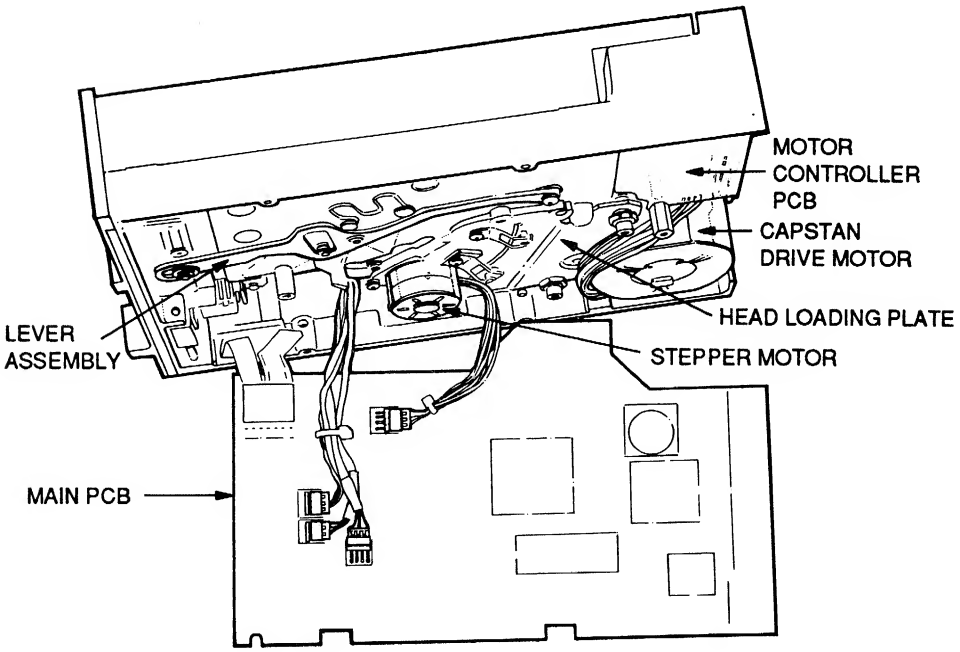


Figure 6. Viper Components (Drive Bottom View)

DRIVE MECHANICS

The following are brief descriptions of the main mechanical assemblies in the Viper tape drive. (Refer to Figures 5 and 6.)

Capstan Drive Motor

The Capstan Drive Motor is a brushless DC motor which drives the cartridge tape via a belt drive system.

Belt Drive System

A semi-elastic, flat Belt Drive transmits mechanical power from the capstan drive motor to the capstan pulley. Crown-and-flanged pulleys are used on both the motor and the capstan assemblies to assure trouble free service.

Capstan Assembly

A Capstan Assembly drives the cartridge drive roller, thus causing tape motion. The capstan is made of long-life urethane and is driven by the belt drive system.

Head Loading Mechanism

The Head Loading Mechanism consists of a loading lever, cartridge ejection lifter, and the head-loading plate assembly which supports the head actuator mechanism.

Head Actuator Mechanism

The Head Actuator Mechanism consists of the head assembly, the head guidance means and stepper motor assembly.

Head Assembly

The Head Assembly has an upper and a lower pair of heads (Read after Write) and a full tape-width AC Erase head. The Read/Write heads in the 60 megabyte Viper are designed for 9-track recording, and the Read/Write heads in the 150 megabyte Viper are designed for 18-track recording. The 18-track head is also capable of reading 9-track (QIC-24) recordings and writing/reading 15-track recordings (QIC-120).

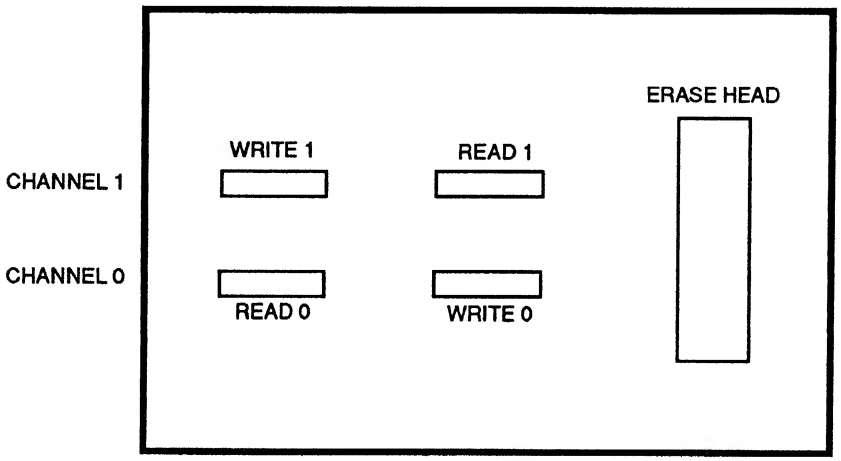


Figure 7. Head Configuration

Safe Switch

The Safe Switch detects the position of the SAFE (Write Protect) plug on the tape cartridge. (Refer to Chapter 4, "Write Protection".)

Cartridge In Switch

The Cartridge In Switch detects whether the cartridge is fully loaded. This switch disables drive operation if the cartridge is not in place.

Tape Hole Sensor Assembly

The Tape Hole Sensor Assembly is an electro-optical sensing assembly consisting of a solid state LED and two photosensors. The photosensors detect the Beginning Of Tape, Load Point, Early Warning, and End Of Tape holes which indicate tape position. The sensors can detect both 450-ft and 600-ft cartridges (see "Tape Holes" paragraph).

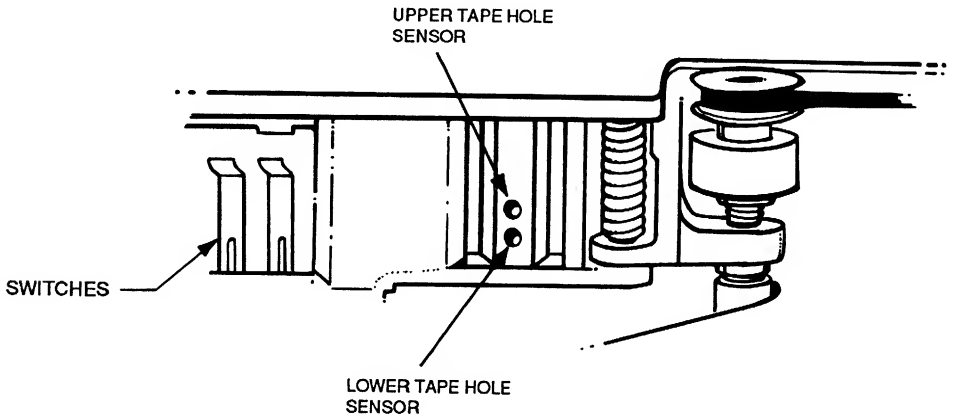


Figure 8. Switches and Tape Hole Sensors

Front Bezel

The Front Bezel of the drive guides a cartridge into the loading aperture and provides ESD protection. The bezel is available in optional colors. The bezel LED is also available in optional colors.

Front Panel LED

The front panel LED is turned on after the cartridge has been inserted and a select command has been accepted by the drive. It stays on until the tape is rewound to the Load Point by a REWIND command. Normally, the cartridge should only be removed when the LED is off.

Drive Electronics

Drive electronics are contained on two printed circuit boards, the Drive and Interface PCB and the Motor Controller PCB. (Refer to Figure 6.)

Drive and Interface PCB

The Viper's Drive and Interface PCB provides the electronics for both the drive operation and the SCSI interface to the host. It includes data formatters for QIC-24, QIC-120 and QIC-150. It provides a serial port for access to Viper resident diagnostics.

Advanced LSI circuitry and surface mount technology have made it possible to integrate the electronics onto this single multilayer board. This integration provides for low power consumption and high data reliability.

The Drive and Interface PCB is conveniently located on the bottom of the drive chassis.

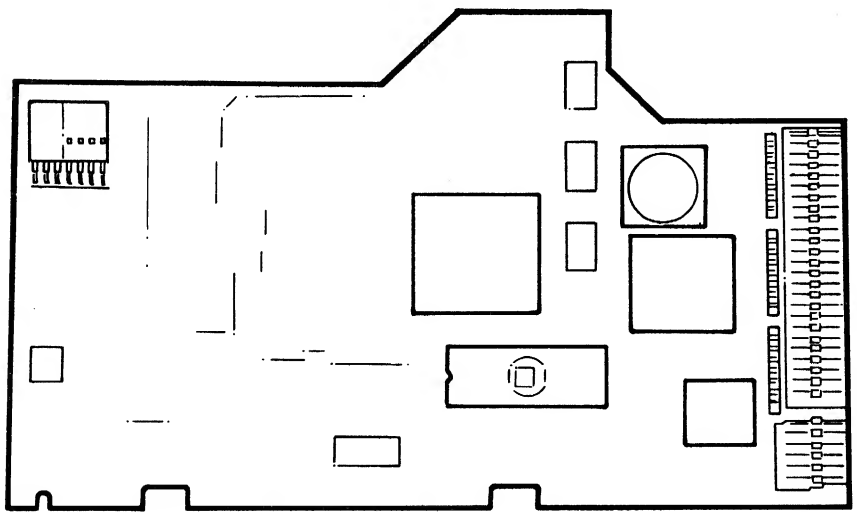


Figure 9. Drive and Interface PCB

Motor Controller PCB

The Viper's "intelligent" Motor Controller PCB utilizes LSI circuitry to initiate and control the signals to the capstan drive motor and thus controls the speed and direction of the tape.

The Motor Controller PCB is mounted in the back of the drive, behind the cartridge area.

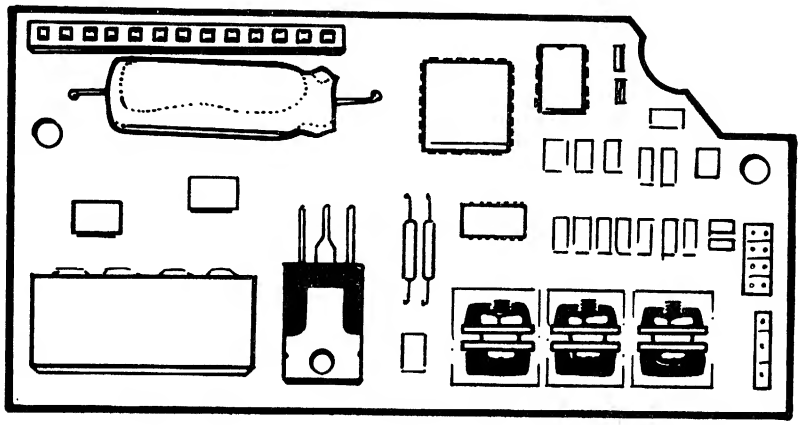


Figure 10. Motor Controller PCB

MEDIA

Tape Cartridge

The Viper records on industry-standard tape cartridges which have been qualified for operation at either 8,000 bpi or 10,000 bpi. Tape cartridges purchased through Archive Corporation are qualified by Archive to operate in the Viper tape drives. Part Numbers for Archive tape cartridges are listed in Appendix A. Tape specifications for the individual Viper models are listed under Specifications at the front of this chapter.

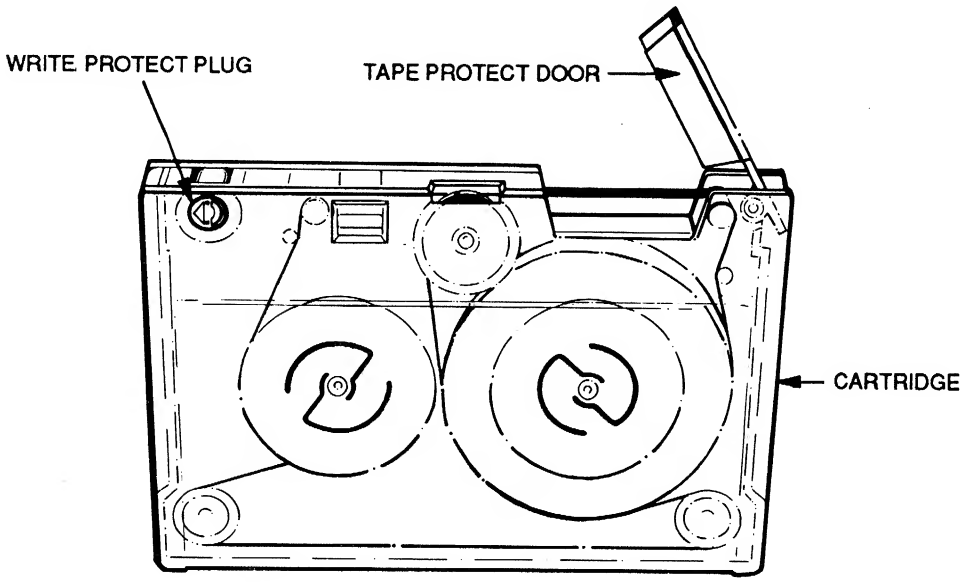


Figure 11. 1/4-Inch Tape Cartridge

Tape Holes

A number of precisely located holes are found near each end of the tape. These holes are detected by the drive sensor assembly (refer to Figure 8) which generates hole-detect signals used to control tape motion.

The tape holes are:

- Beginning Of Tape (BOT) - six holes (in pairs) indicating the Beginning-Of-Tape position.
- End Of Tape (EOT) - three holes indicating the End-Of-Tape position.
- Load Point (LP) - one hole near BOT indicating the start of recorded data.
- Early Warning (EW) - one hole near EOT indicating the end of the tape is near.

LP and EW holes exchange functions when the tape movement is in the reverse direction.

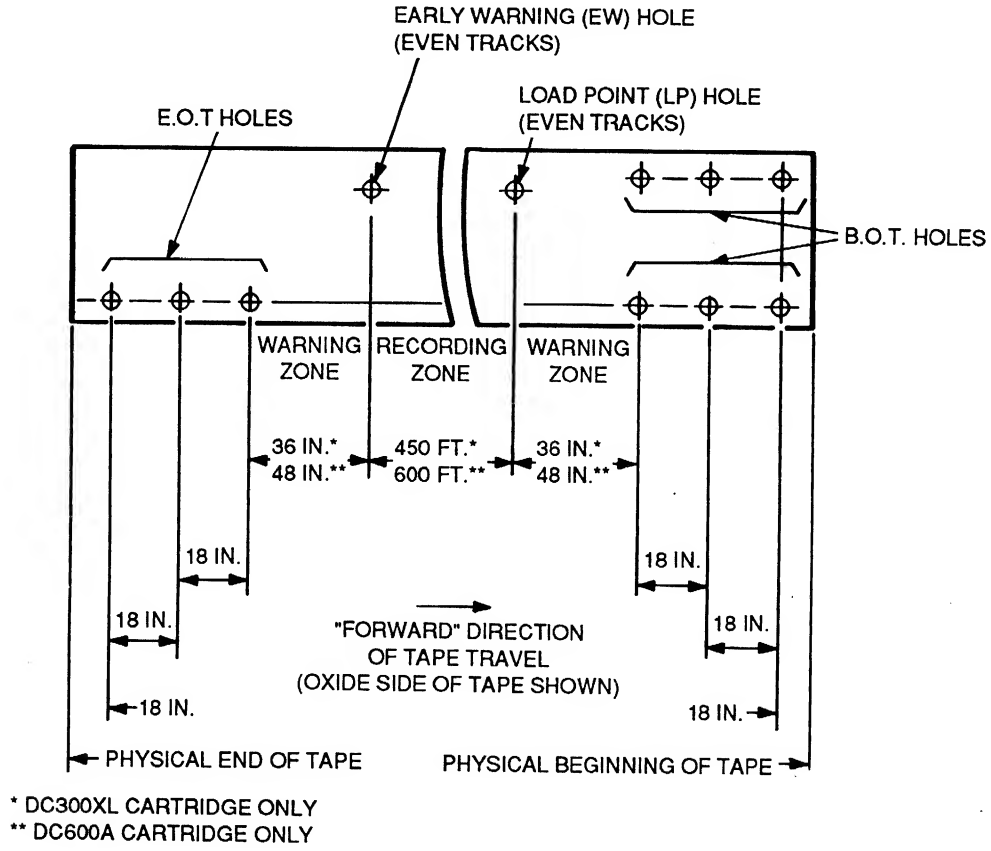


Figure 12. Tape Hole Format

Chapter 4
FUNCTIONAL DESCRIPTIONS

SPECIAL FEATURES

Direct Block Addressing

Instead of sequentially searching through tracks for a requested block of data, the Viper is capable of stepping the head directly to the track and searching for the requested block. The Request Block Address and Seek Block commands provide this capability. (See Chapter 6 for details.)

Large Buffer Size

The Viper has a 64 Kbyte data buffer. This large buffer size permits efficient handling of high data burst transfer rates up to 1.8 megabytes per second. In addition, it helps to keep the tape streaming during host computer delay times.

Selectable Buffer Disconnect

The user can select, via a jumper on the Main PCB, the buffer transfer size option which best suits the application. During lengthy data transfer operations, this feature periodically frees the host bus for other SCSI bus operations.

Edge Of Tape (2150S Only) and Reference Burst Sensing

To write on a blank cartridge, the drive must first locate the nominal position for Track 0. With edge of tape sensing, the Viper drive senses the bottom edge of the tape and uses this reference position to step the heads to Track 0 position. The Track 0 reference burst is then written in the Load zone, between the BOT holes and the start of recorded data, on Track 0. All other tracks are then positioned with respect to Track 0.

To Read a tape cartridge, the drive uses reference burst sensing to automatically align the heads to the center of the reference burst on Track 0.

Resident Diagnostics

The Viper Main PCB contains a built-in serial port for access to drive diagnostic routines. This feature allows troubleshooting and diagnosis without the use of an external computer.

High Speed End-of-Data Access

The SPACE command can rapidly position the tape after the last recorded data. This is usually done in preparation for appending new data to the tape. Viper will skip over recorded tracks and directly access the end-of-recorded-data point. This can save substantial time when doing a tape update. Data may be written to tape only at BOM (beginning of media) or at the end-of-recorded data.

Backward Compatibility

Host interface commands permit the host system to override the Model 2150S default (18-track) tape format mode. The host can set the 2150S to read but not write 310 oersted tape cartridges, such as the DC300XLP, which are recorded in QIC-24 (9-track) tape format. The host can set the 2150S to read and write on DC600A cartridges that are recorded in the QIC-120 (15-track) tape format.

The Viper drive differentiates between tape formats by detecting the location of the track zero reference burst.

DRIVE FUNCTIONS

Cartridge Loading and Ejecting

To load a cartridge, insert it into the loading aperture oriented as shown in Figure 13. Push the cartridge in until it reaches a hard stop; then press either downward or laterally, depending upon whether the drive is mounted horizontally or vertically, until the cartridge drops behind the front lip of the aperture. Move the head loading lever as far as it will move toward the cartridge. This action secures the cartridge and loads the head assembly into operating position.

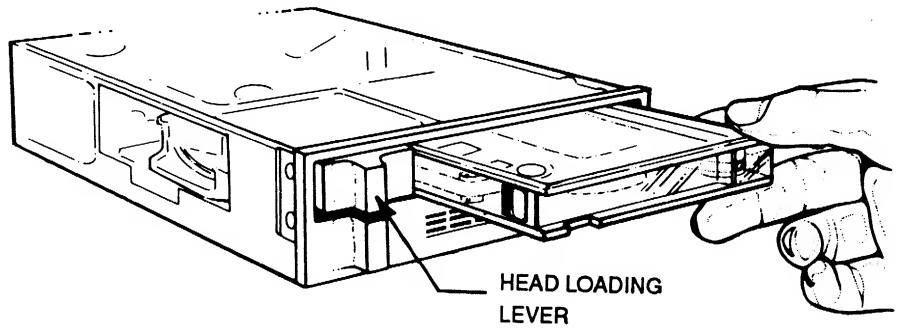
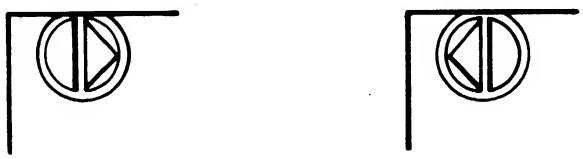


Figure 13. Cartridge Loading

The cartridge is ejected by sliding the loading lever away from the cartridge. The head assembly retracts, and the cartridge ejection system pushes the cartridge up and out of the drive.

Write Protection

The tape cartridge is equipped with a write-protect plug which can be rotated by the user before cartridge insertion to either the Safe or Unsafe position. The Safe position designates that writing to the tape is inhibited (see Figure 14). The Safe Switch in the drive detects the position of the cartridge write-protect plug.



Safe Position **Unsafe Position**

Figure 14. Cartridge Write-Protect Plug

Tape Motion

Tape motion is controlled by the Viper's Motor Controller circuitry. The Motor Controller LSI circuits send the motion control signals to the capstan drive motor. When a cartridge is loaded in the drive, the motor capstan makes contact with a belt capstan in the cartridge. The belt capstan drives both the supply and take-up hubs in the cartridge, causing the tape to move past the Read and Write heads and the tape-hole sensors.

Serpentine Recording

"Serpentine" accurately describes the streaming tape drive pattern of recording serial data on tape. The recorded tape appears logically to consist of one long, winding track. In reality, logically adjacent tracks are recorded, one track at a time, in opposite directions (even-numbered tracks in the forward direction and odd-numbered tracks in the reverse direction). This process takes advantage of the tape cartridge bi-directional capabilities and, thus, avoids time-consuming rewinds. Illustrations of the 9-track, 15-track and 18-track serpentine patterns follow.

Here is a basic description of how the serpentine pattern is created. Writing begins on Track 0 with the lower pair of heads enabled while moving from BOT to EOT. When EOT is reached, the lower pair of heads is disabled and the upper pair of heads is enabled. The capstan motor is then reversed, and Track 1 is written while the tape moves from EOT to BOT. When BOT is reached the tape motion pauses. The head assembly is positioned at the next track-pair, and the above process is repeated until all tracks are written.

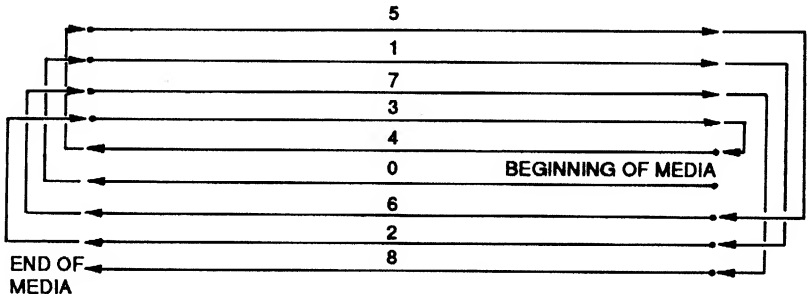


Figure 15. Serpentine Recording Pattern: 9-Track

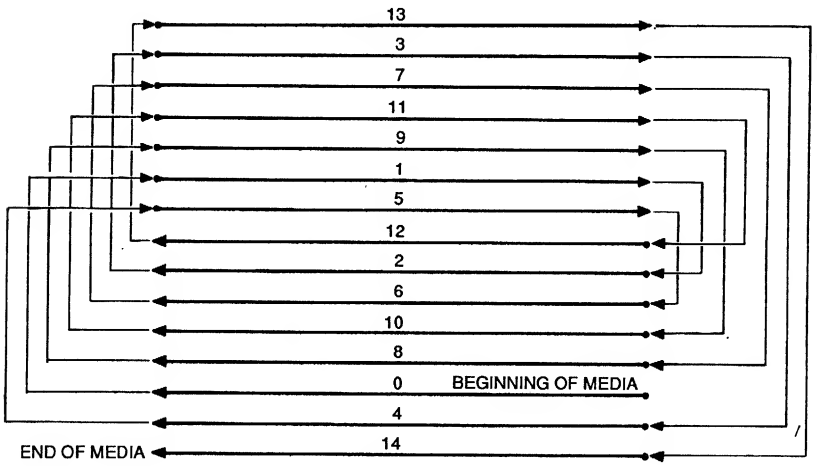


Figure 16. Serpentine Recording Pattern: 15-Track

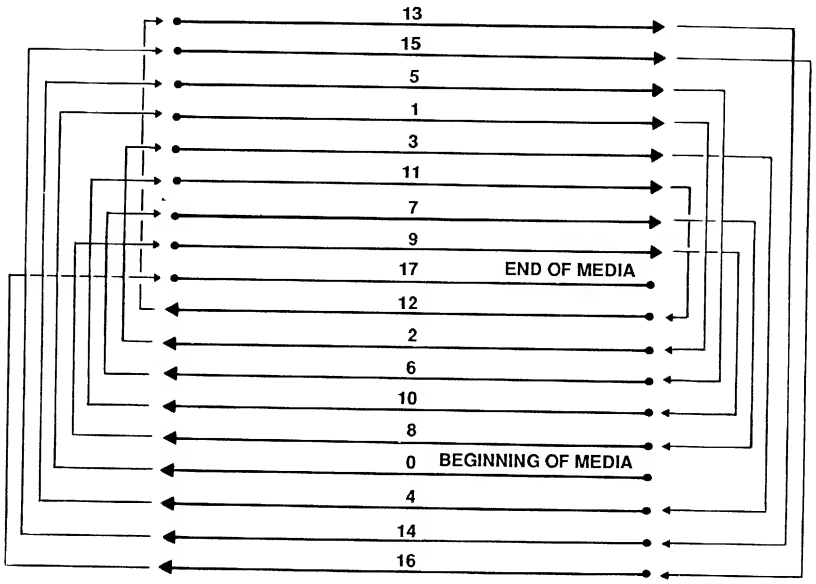


Figure 17. Serpentine Recording Pattern: 18-Track

Head Assembly Operation

The upper and lower Read-after-Write head pair construction permits read-after-write error detection and the bi-directional serpentine track pattern described above.

To the right of the head pairs is the full tape-width AC erase head. The erase head precedes the Write head on Track 0. As Track 0 is written, the erase head erases the full width of the tape and is disabled at the end of Track 0. The drive command set also allows for a full erase pass prior to writing, or for security purposes.

The head assembly is positioned vertically by a stepper motor. The stepper motor and associated control circuits move the head assembly the required number of electronically calculated steps to a designated track. Precise positioning of the head assembly is essential to assure media interchangeability from one drive to another. The Viper uses edge of tape sensing to precisely locate the position for Track 0, and then uses Track 0 as a reference point to step to the other track locations.

Tape Formatting

The Viper model 2060S is designed to write data in the QIC-24 (9-track) format. QIC-24 recording density is 10,000 flux transitions per inch (ftpi).

The Viper model 2150S is designed to write data in either the QIC-150 (18-track) or QIC-120 (15-track) format. QIC-150 and QIC-120 recording densities are 12,500 ftpi.

In both formatting systems the data block contains 512 bytes of information. The block format is as shown in Figure 17. The method of recording is non-return to zero, change on one (NRZI). Data is encoded using the group code recording (GCR) method, where 4 bits of data is encoded into a 5-bit group.

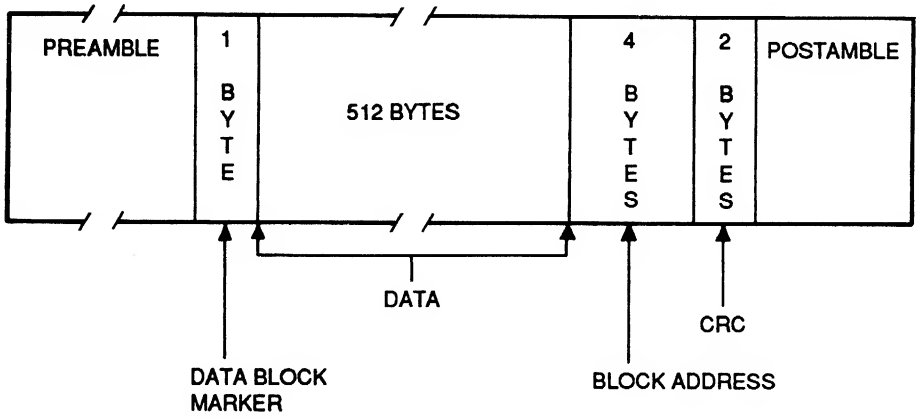


Figure 18. Data Block Format

Chapter 5
HARDWARE INTERFACE

COMMUNICATIONS INTERFACE

LSI circuitry implements the Viper's signal interface. Firmware resident in the Drive and Interface PCB implements the SCSI logic for exchange of formatted message, status, data, and command information between the Viper and its host via the signal interface. The "S" designation at the end of the Viper model number indicates the SCSI interface is configured. SCSI logical communication is described in Chapter 6. The following paragraphs describe the Viper's signal interface to the host.

Connectors

Hardware interface is through a 50-pin connector which is mounted on the Drive and Interface PCB at the rear of the drive. Viper SCSI models use a right-angle, dual-row pin connector, illustrated below.

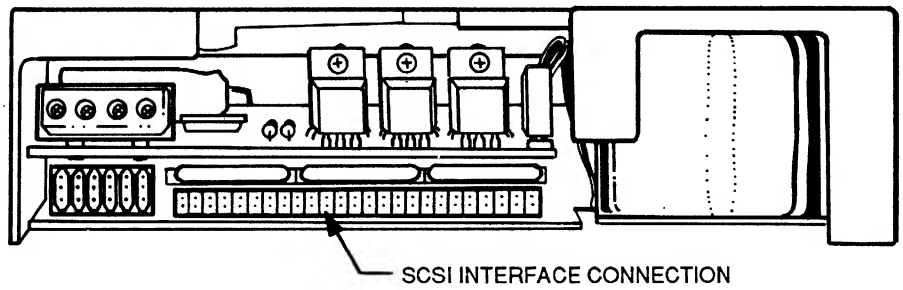


Figure 19. Viper Rear View

Signal Conventions

The following conventions are used to describe interface signal notation.

- active = True; inactive = False
- signal name or abbreviation followed by a - (dash) indicates that the signal is active-Low; for example: ONL-

All interface signals are active-Low.

Pin Assignments and Descriptions

All odd pins, except Pin 25, are connected to signal ground at the host. Pin 25 is left open.

PIN NO.	SIGNAL	DESCRIPTION
2	DB(0)-	Data Bus Bit 0 (LSB)
4	DB(1)-	Data Bus Bit 1
6	DB(2)-	Data Bus Bit 2
8	DB(3)-	Data Bus Bit 3
10	DB(4)-	Data Bus Bit 4
12	DB(5)-	Data Bus Bit 5
14	DB(6)-	Data Bus Bit 6
16	DB(7)-	Data Bus Bit 7 (MSB)
18	DB(P)-	Data Bus Parity
20	GROUND	
22	GROUND	
24	GROUND	
26	TERMINATOR POWER	+5 power for terminator
28	GROUND	
30	GROUND	
32	ATN-	Attention
34	GROUND	
36	BSY-	Busy
38	ACK-	Acknowledge
40	RST-	Reset
42	MSG-	Message
44	SEL-	Select
46	C/D-	Control/Data
48	REQ-	Request
50	I/O-	Input/Output

Signal Descriptions

The Viper SCSI interface consists of eighteen signals. Nine are control lines and nine are data lines. (Data lines include the parity signal option). These signals are described as follows.

BSY- (Busy) is an "OR-tied" signal which indicates that the data bus is in use.

SEL- (Select) is used by an initiator to select a target, or by a target to re-select an initiator.

C/D- (Control/Data) is driven by a target and indicates whether CONTROL or DATA information is on the data bus. True indicates CONTROL.

I/O- (Input/Output) is driven by a target and controls the direction of data movement on the data bus with respect to an initiator. This signal is also used to distinguish between Selection and Re-selection phases. True indicates input to the initiator.

MSG- (Message) is driven by a target during the Message phase.

REQ- (Request) is driven by a target to indicate a request for a REQ/ACK data transfer handshake.

ACK- (Acknowledge) is driven by an initiator to indicate an acknowledgement for a REQ/ACK data transfer handshake.

ATN- (Attention) is driven by an initiator to indicate the ATTENTION condition.

RST- (Reset) is an "OR-tied" signal that indicates the RESET condition.

DB- (7-0,P) (Data Bus) are eight data-bit signals plus a parity bit signal that form the data bus. DB(7) is the MSB and has the highest priority during the ARBITRATION phase. Data parity is odd and is a jumper-selectable option. Parity is not valid during the ARBITRATION phase.

The BSY- and RST- signals are the only OR-tied signals. In ordinary operation of the bus, these signals are simultaneously driven by two or more drivers. Any signal other than BSY- and RST- may employ OR-tied or non-OR-tied drivers. There is no operational problem in mixing OR-tied and non-OR-tied drivers on signals other than BSY- and RST-. DB(P) is not to be driven False during the ARBITRATION phase.

Interface Signal Levels

Signals driven by the drive have the following output characteristics, when measured at the interface connector.

Inactive-False (High)	2.5 to 5.25 VDC
Active-True (Low)	0.0 to 0.4 VDC

Signals received by the drive have the following input characteristics, when measured at the interface connector.

Inactive-False (High)	2.0 to 5.25 VDC
Active-True (Low)	0.0 to 0.80 VDC

Signal Terminations

Signal terminations are 220 ohms to +5 VDC and 330 ohms to Ground. All signals use open-collector or three-state drivers.

Signal Loading

Viper's minimum driver output capability is 48 mA (sinking) at 0.5 VDC. Maximum total input load is -0.4 mA at 0.4 VDC.

Chapter 6
SCSI INTERFACE

CONFIGURATION

Viper models 2060S and 2150S are configured with a SCSI interface for communication with a host. The Viper SCSI is implemented in compliance with ANSI X3.131 (Small Computer System Interface) and QIC-104 (SCSI sequential storage device implementation standard).

The information provided in this chapter is to be used in conjunction with ANSI X3.131 and QIC-104.

Controller ID

The Viper controller network ID (SCSI ID) is configured by the jumpers on the rear assembly.

Bus Arbitration

Full SCSI arbitration with disconnect and reconnect is supported for multi-target/multi-initiator systems.

Logical Unit Addressing

The single tape drive in the Viper is logical unit number (LUN) zero. The Viper always addresses LUN zero of the connected initiator.

Vendor Unique Random Access Support

The Viper command set includes support for random access processing and applications. The vendor-unique SEEK BLOCK command performs rapid positioning of the tape to a specified block location. Conversely, the specific block address of the tape's current position may be obtained with the REQUEST BLOCK ADDRESS command.

Support is also provided for user applications that maintain strategic block addresses in a trailing directory. Typically, a directory maintains the beginning block for each of the individual files on the tape. For the case that the directory is located at the end-of-recorded-data, the SPACE command functions permit rapid positioning to the directory.

These capabilities are expanded upon in the individual command descriptions.

Message Codes

The following messages are supported by Viper:

CODE	DESCRIPTION	DIRECTION
00H	Command Complete	In
02H	Save Data Pointer	In
04H	Disconnect	In
05H	Initiator Detected Error	Out
06H	Abort	Out
07H	Message Reject	In/Out
08H	No Operation	Out
0AH	Linked Command Complete	In
0BH	Linked Command Complete With Flag	In
0CH	Bus Device Reset	Out
80H-87H	Identify (no Disconnect/Reconnect)	In/Out
C0H-C7H	Identify (Disconnect/Reconnect)	Out

Status Codes

The following 4-bit status codes are used by Viper.

STATUS CODE (4-bits)	DEFINITION
4 3 2 1	
0 0 0 0	GOOD STATUS
0 0 0 1	CHECK CONDITION
0 1 0 0	BUSY
1 0 0 0	INTERMEDIATE STATUS
1 1 0 0	RESERVATION CONFLICT

Command Codes

The following X3.131 Group 0 commands for sequential access devices are implemented by Viper.

CODE	TYPE	COMMAND NAME
00H	O	Test Unit Ready
01H	M	Rewind
02H	V	Request Block Address
03H	M	Request Sense
05H	E	Read Block Limits
08H	M	Read
0AH	M	Write
0CH	V	Seek Block
10H	M	Write File Marks
11H	O	Space
12H	E	Inquiry
13H	O	Verify
14H	O	Recovered Buffered Data
15H	O	Mode Select
16H	O	Reserve Unit
17H	O	Release Unit
18H	O	Copy
19H	O	Erase
1AH	O	Mode Sense
1BH	O	Load/Unload
1DH	O	Send Diagnostic
1EH	O	Prevent/Allow Medium Removal
KEY	M =	mandatory command.
	E =	extended command.
	O =	optional command.
	V =	vendor unique.

ANSI X3.131 Conformance Statement

ALTERNATIVES

(1) Single-ended drivers
(2) Termination power supplied by the cable
(3) Parity implemented (jumpered)
(4) Hard reset
(5) Reservation queueing is NOT implemented

LEVEL

0, 1 , and 2

OPTIONAL COMMANDS

(1) Test Unit Ready
(2) Send Diagnostic
(3) Space
(4) Verify
(5) Recover Buffered Data
(6) Mode Select
(7) Reserve Unit
(8) Release Unit
(9) Erase
(10) Mode Sense
(11) Load/Unload
(12) Copy

OPTIONAL MESSAGES (AS A TARGET DEVICE)

Send:

(1) Identify
(2) Message Reject
(3) Disconnect
(4) Save Data Pointers
(5) Linked Command Complete
(6) Linked Command Complete With Flag

Receive:

(1) Identify
(2) Message Reject
(3) Abort
(4) Initiator Detected Error
(5) No Operation
(6) Bus Device Busy

OPTIONAL MESSAGES (AS AN INITIATOR DEVICE)

Send:

(1) Identify
(2) Message Reject
(3) Abort
(4) Initiator Detected Error

Receive:

(1) Identify
(2) Message Reject
(3) Disconnect
(4) Save Data Pointers
(5) Restore Pointers

OTHER OPTIONS

(1) "Fixed" block transfer lengths only.
(2) Space blocks, filemarks, sequential filemarks, and EOD (forward and reverse)
(3) Verify is Medium verification only.
(4) Mode Select allows changes only for buffer mode and tape format.
(5) Support 3rd party reservation.
(6) Live in both single and multi initiator systems.
(7) No 3rd party Copy

VENDOR UNIQUE COMMANDS

(1) Seek block.
(2) Request block address.

SCSI Pointers

SCSI architecture provides for two sets of three pointers within each initiator. Whenever a physical path is established with a host that can accommodate disconnection and reconnection, the host must insure that its Current Pointers for the path are equal to the Saved Pointers in the Viper. (An implied RESTORE POINTERS operation occurs in the Viper as a result of a connect or reconnect.)

Current Pointers

Also known as the Active Pointers, these pointers are used to represent the state of the interface and point to the next COMMAND, STATUS or DATA byte to be transferred between the initiator's memory and the target. There is only one set of Current Pointers in each initiator. The Current Pointers are used by the target currently connected to the initiator.

Saved Pointers

There is one set of Saved Pointers for each command that is currently active (whether or not it is currently connected). The set includes COMMAND, STATUS and DATA pointers which point to the Command Descriptor Block, Status Area and Data Area, respectively, for the current command.

The saved data pointer will continue to point to the start of the Data Area until the target sends a SAVE DATA POINTER message to the initiator. In response to the SAVE DATA POINTER message the initiator replaces the value of the saved data pointer with the current (active) data pointer.

A target may restore current pointers to their saved values by sending the RESTORE POINTERS message to the initiator. In response to a RESTORE POINTERS an initiator returns the saved pointers to their corresponding current pointers.

The Viper does not send RESTORE POINTERS messages. The Viper can receive a RESTORE POINTERS when it is acting as the initiator for a COPY command.

Whenever a SCSI device disconnects from the bus, only the saved pointer values are retained. The current pointer values are restored from the saved values upon the next reconnect.

MESSAGE DESCRIPTIONS

Logical Path Establishment

An initiator that is able to accommodate more than just the COMMAND COMPLETE MESSAGE (required of all SCSI devices) will indicate this to the Viper during the Selection Phase by asserting ATN before bus condition SEL true, BSY false. This will cause the Viper to enter the Message Out Phase when the Selection Phase completes.

The first message sent by the host after the Selection Phase shall be an IDENTIFY message. The first message sent by the Viper after a Reselection Phase is also IDENTIFY. Under certain exceptional conditions the host may send the ABORT message or the BUS DEVICE RESET message instead of IDENTIFY as the first message.

The purpose of IDENTIFY messages are to establish a physical path between an initiator and target for a particular logical unit. The IDENTIFY message contains the logical unit number (LUN). The single tape drive in the Viper controller must be identified by the initiator as logical unit zero. The Viper always addresses logical unit zero of the initiator.

The following paragraphs describe the use of the twelve SCSI messages.

ABORT (06H)

This message is sent from the initiator to Viper to clear the present operation. All pending data and status for the issuing initiator will be cleared and Viper will go to the BUS FREE phase. No status or ending message is sent for the operation. It is not an error to issue this message to Viper even if it is not currently performing an operation for the initiator.

BUS DEVICE RESET (0CH)

This message is sent from an initiator to direct Viper to clear all current commands. This message forces Viper to an initial state with no operations pending for any initiator. Upon recognizing this message, Viper will go to the BUS FREE phase.

COMMAND COMPLETE (00H)

This message is sent from Viper to an initiator to indicate that the execution of a command (or a series of linked commands) has terminated and that valid status has been sent to the initiator. After successfully sending this message, Viper will go to the BUS FREE phase by releasing BSY.

NOTE: The command may have been executed successfully or unsuccessfully as indicated in the status.

DISCONNECT (04H)

This message is sent from Viper to inform an initiator that the present physical path is going to be broken (Viper plans to disconnect by releasing BSY), and that a later reconnect will be required in order to complete the current operation.

If the initiator detects the BUS FREE phase (other than as the result of a RESET condition) without first receiving a DISCONNECT or COMMAND COMPLETE message, the initiator shall consider this as a catastrophic error condition.

The DISCONNECT message shall not cause the initiator to save the data pointer. If DISCONNECT messages are used to break a long data transfer into two or more shorter transfers, then a SAVE DATA POINTER message will be issued by the Viper before each DISCONNECT.

NOTE: Configuration jumpers are used to select the disconnect size. (Refer to Chapter 2 - Installation.

IDENTIFY (80H - 87H No Disconnect/Reconnect) (C0H - C7H Disconnect/Reconnect)

These messages are sent by either the initiator or Viper to establish the physical path connection between them.

Bit 7. This bit is always set to one to distinguish these messages from other messages.

Bit 6. This bit is only set to one by the initiator. When set to one, it indicates that the initiator has the ability to accommodate disconnection and reconnection.

Bits 5-3. Reserved (set to zero).

Bits 2-0. These bits specify the logical unit number which must be 0.

When IDENTIFY is sent from Viper to an initiator during reconnection, an implied RESTORE POINTERS message shall be performed by the initiator prior to completion of this message.

INITIATOR DETECTED ERROR (05H)

This message is sent from an initiator to inform Viper that an error (e.g., parity error) has occurred.

LINKED COMMAND COMPLETE (0AH)

This message is sent from Viper to an initiator to indicate that execution of a linked command has completed and that status has been sent. The initiator shall then set the pointers to the initial state for the next linked command.

LINKED COMMAND COMPLETE WITH FLAG (0BH)

This message is sent from Viper to an initiator to indicate that execution of a linked command (with the Flag bit set to one) has completed and that status has been sent. The initiator shall then set the current pointers to the initial state of the next linked command.

Typically this message would be used to cause an interrupt in the initiator between two linked commands.

MESSAGE REJECT (07H)

This message is sent from Viper to indicate that the last message it received was inappropriate or has not been implemented. The Viper sends MESSAGE REJECT and then goes to the MESSAGE IN phase prior to requesting additional message bytes from the initiator. This provides an interlock so that the initiator can determine which message has been rejected.

NO OPERATION (08H)

This message is sent from an initiator in response to Viper's request for a message when the initiator does not currently have any other valid message to send.

SAVE DATA POINTER (02H)

This message is sent from Viper to direct the initiator to save a copy of the present active data pointer for Viper. (Refer to section "SCSI Pointers" for a definition of pointers.)

STATUS DESCRIPTIONS

A status byte is sent from Viper to the initiator during the STATUS phase at the termination of each command unless the command is cleared by an ABORT message, by a BUS DEVICE RESET message, or by a "hard" RESET condition.

7	6	5	4	3	2	1	0
0	0	0	Status Code				0

Status Byte Format

The following paragraphs describe the use of the five SCSI status codes.

BUSY (4H)

Viper is busy. This status is returned whenever Viper is unable to accept a command from the initiator. The normal initiator recovery action is to issue the command again at a later time.

CHECK CONDITION (1H)

Any error, exception, or abnormal condition that causes the sense data to be set, will cause a CHECK CONDITION status. A REQUEST SENSE command should be issued following a CHECK CONDITION status, to determine the nature of the condition.

GOOD STATUS (0H)

This status indicates that Viper has successfully completed the command.

INTERMEDIATE STATUS (8H)

This status is returned for every command in a series of linked commands (except the last command) unless an error, exception, or abnormal condition causes either CHECK CONDITION or RESERVATION CONFLICT status to be set. If this status is not returned, the chain of linked commands is broken and no further commands in the series are executed.

RESERVATION CONFLICT (CH)

This status is returned whenever a SCSI device attempts to access Viper when it is reserved for access to another SCSI device.

COMMAND DESCRIPTIONS

Command Descriptor Block

A request to a peripheral device is performed by sending a Command Descriptor Block to the target. For several commands, the request is accompanied by a list of parameters sent during the DATA OUT phase.

If an invalid parameter is contained in the Command Descriptor Block, Viper will terminate the command without altering the medium.

A typical Group 0 (six-byte) Command Descriptor Block (CDB) is shown below:

=Byte=	7	6	5	4	3	2	1	0
0	Group Code			Command Code				
1	Logical Unit No.			Command Dependent				
2	Command Dependent							
3	Command Dependent							
4	Command Dependent							
5	Vendor Unique		0	0	0	0	Flag	Link

Command Descriptor Block Format

The following CDB fields are common to all Group 0 commands:

Group Code[1] - This field indicates which of eight possible SCSI command groups is specified. It shall always be zero to indicate a Group 0 (six-byte) command.

Command Code[1] - This field indicates which of 32 possible command codes for a particular group code is specified.

Logical Unit No.[2] - The logical unit number must be set to zero.

Vendor Unique - These bits are ignored.

Flag bit - The Flag bit is used only in conjunction with the Link bit and must be set to zero if the Link bit is zero. When the Link bit is set, the value of the Flag bit determines the appropriate message to send to the initiator when a linked command completes successfully; value zero indicates the LINKED COMMAND COMPLETE message is required, value one indicates the LINKED COMMAND COMPLETE WITH FLAG message is required. Typically, the Flag bit is used to cause an interrupt in the initiator at the end of or at logical intervals in linked command processing.

Link bit[3] - The Link bit is used to indicate that the initiator desires automatic linking to the next command upon successful completion of the current command. When the Link bit is one, upon successful termination of the command, Viper returns INTERMEDIATE STATUS followed by one of the two COMMAND COMPLETE messages as determined by the Flag bit. (See above).

[1]Together, group code and command code make up the op code. The op codes for the Viper command set are shown in the Configuration section at the beginning of this chapter.

[2]If a non-zero unit number is received in a CDB, a CHECK CONDITION status is returned and Extended sense Key is set to NOT READY (reflecting the non-existent tape drive's status).

[3]If the Link bit is used, all applicable commands (REWIND, SEEK BLOCK, and LOAD/UNLOAD) must have the IMMED bit set to zero or a CHECK CONDITION status is returned and Extended sense Key is set to ILLEGAL REQUEST.

The following CDB fields are command dependent:

IMMED bit - The immediate bit is used with a number of commands to request that status be returned as soon as the operation is initiated. When required, the IMMED bit resides in byte 1, bit 0 of the CDB.

Allocation Length - This field is used in a number of commands to specify the number of bytes the initiator has allocated for the command's response data. When this field is zero, the Viper transfers the command's full response to the host. In the case this field is non-zero, but less than the full response length, the Viper truncates its response when the Allocation Length is exhausted.

All other command dependent fields are defined within the message descriptions that follow.

COPY (Op Code = 18H)

The COPY command provides a means to copy data blocks between a Viper drive and other SCSI devices. Other devices must be of the type Sequential or Direct Access. The Viper will manage the data transfers by assuming the role of initiator to establish a logical connection with the other device. Third party copying is not supported; that is, the Viper will not manage transfers between two remote devices but will manage transfers between itself and a remote device.

The COPY command may include up to 256 Segment Descriptors, each identifying a different remote device or (for Direct Access devices) starting block address. The Viper processes one Segment Descriptor at a time. The position of the Viper tape is not rewound between processing of each Segment Descriptor.

The Viper will issue read or write type commands to the other device, depending on whether the remote device is the source or destination for the data. Each command will have a data length equivalent to the remote device's block size. The block sizes of Sequential devices are specified in the Segment Descriptors. To determine the block size of remote Direct Access devices, the Viper will issue a MODE SENSE command each time a new Segment Descriptor is processed.

The Viper accommodates devices with a block size equal to one of the following: 256, 512, 1024, 2048 and 4096 bytes. Since the block size for a Viper drive is always 512, when the other device has a block size of 256 the number of blocks to be copied must be an even number.

Bus transfer length will be equivalent to the Viper's internal buffer size as configured by the Disconnect Size jumpers on the rear assembly and must be equal to or greater than 8K. (Refer to Chapter 2, "Jumper Configuration".)

The initiator that issues the COPY command is responsible for any applicable device reservations (see RESERVE UNIT command description), for positioning the tape to the starting source/destination positions on sequential devices, and for insuring/determining that the device to be logically connected to the managing Viper has been properly initialized.

The Viper COPY implementation adheres to the ANSI X3.131 standard in all respects not specifically noted above and in the following pages.

The initiator sends the following Command Control Block to the Viper that is to manage the COPY:

=Byte=	7	6	5	4	3	2	1	0
0	0	0	0	1	1	0	0	0
1	0	0	0	0	0	0	0	0
2	Parameter List Length -- MSB							
3	Parameter List Length							
4	Parameter List Length -- LSB							
5	X	X	0	0	0	0	Flag	Link

Parameter List Length contains the total number of bytes in the trailing parameter list, including the 4-byte Header plus all Segment Descriptors.

=Byte=	7	6	5	4	3	2	1	0
0	COPY Function Code						Priority	
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0

COPY Parameter List Header Format

Byte 0, bits 0-2 (Priority) are ignored since the Viper does not queue commands. The COPY command must complete before a subsequent command will be accepted.

COPY Function Code in the Parameter List Header specifies the format of the subsequent Segment Descriptors. The Viper COPY supports a subset of the COPY functions defined in the ANSI X3.131 standard. This subset is based on the restriction that the Viper must be considered a Sequential device when participating in a COPY.

The following chart illustrates which COPY functions are supported in terms of the standard COPY Function Codes.

COPY FUNCTION CODE	USE	RESTRICTION
00h	D/A to SEQ	Source device cannot be a Viper.
01h	SEQ to D/A	Destination cannot be a Viper.
02h	D/A to D/A	Not supported.
03h	SEQ to SEQ	Device cannot copy to itself

D/A = Direct Access Device
SEQ = Sequential Device

In the following Segment Descriptors, designation of SCSI I.D. for a Viper device must match the SCSI I.D. configured on the drive's rear assembly. (See Chapter 2, "Jumper Configuration".)

=Byte=	7	6	5	4	3	2	1	0
0	Source's SCSI ID			0	0	Source LUN		
1	Viper's SCSI ID			0	0	0	0	0
2	0	0	0	0	0	0	1	0
3	0	0	0	0	0	0	0	0
4	D/A Device Number of Blocks — MSB							
5	D/A Device Number of Blocks							
6	D/A Device Number of Blocks							
7	D/A Device Number of Blocks — LSB							
8	D/A Device Logical Block Address — MSB							
9	D/A Device Logical Block Address							
10	D/A Device Logical Block Address							
11	D/A Device Logical Block Address — LSB							

D/A to SEQ Segment Descriptor Format

The Viper must be the destination device in a D/A to SEQ copy. Byte 1 bits 0-2 (Destination LUN) have value 0, referencing the controller's single drive. Bytes 2-3 (SEQ Device Block Length) have value 512, as per the Viper recording format.

In the case where the D/A device block size is 256, the 24-bit count in D/A Device Number of Blocks must be an even number.

A block count of zero is permitted and will cause a read type command to be issued to the D/A device with a Transfer Length of zero.

The type of read command is a function of the value in D/A Device Logical Block Address: If the value of the logical block address is equal to or greater than 2^{21}, a Read Extended (28h) will be used. When the Read Extended command is required, the RelAdr bit of the D/A Read Extended Command Descriptor Block is not used.

=Byte=	7	6	5	4	3	2	1	0
0	Viper's SCSI I.D.			0	0	0	0	0
1	Destination's SCSI I.D.			0	0	Destination LUN		
2	0	0	0	0	0	0	1	0
3	0	0	0	0	0	0	0	0
4	D/A Device Number of Blocks — MSB							
5	D/A Device Number of Blocks							
6	D/A Device Number of Blocks							
7	D/A Device Number of Blocks — LSB							
8	D/A Device Logical Block Address — MSB							
9	D/A Device Logical Block Address							
10	D/A Device Logical Block Address							
11	D/A Device Logical Block Address — LSB							

SEQ to D/A Segment Descriptor

The Viper must be the source device in a SEQ to D/A copy. Byte 0 bits 0-2 (Source LUN) have value 0, referencing the controller's single drive. Bytes 2-3 (SEQ Device Block Length) have value 512, as per the Viper recording format.

In the case where the D/A device block size is 256, the 24-bit count in D/A Device Number of Blocks must be an even number.

A block count of zero is permitted and will cause a write type command to be issued to the D/A device with a Transfer Length of zero.

The type of write command is a function of the value in D/A Device Logical Block Address: If the value of the logical block address is equal to or greater than 2^{21}, a Write Extended (2Ah) will be used. When the Read Extended command is required, the RelAdr bit of the D/A Read Extended Command Descriptor Block is not used.

=Byte=	7	6	5	4	3	2	1	0
0	Source's SCSI I.D.			0	0	Source LUN		
1	Destination's SCSI I.D.			0	0	Destination LUN		
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	Source Block Length -- MSB							
5	Source Block Length -- LSB							
6	Destination Block Length -- MSB							
7	Destination Block Length -- LSB							
8	Source Number of Blocks -- MSB							
9	Source Number of Blocks							
10	Source Number of Blocks							
11	Source Number of Blocks -- LSB							

SEQ to SEQ Segment Descriptor

The managing Viper may be either the source or destination device in a SEQ to SEQ copy. The LUN associated with a Viper must always have value 0, referencing the controller's single drive. The Block Length associated with a Viper must always have value 512, as per the Viper recording format.

In the case where the remote device's block size is 256, the 24-bit count in Source Number of Blocks must be an even number.

Exception handling:

Exceptions may be detected by either the Viper managing the COPY or by the remote device.

When the remote device (the target) detects an exception condition, CHECK CONDITION status is sent to the managing Viper. The managing Viper, in turn, generates a CHECK CONDITION status for the initiator that issued the COPY command. The Extended Sense Data that is prepared by the managing Viper will have Key set to COPY ABORT, indicating that the error occurred at the target device, and will include Sense Data from the target device when available. (See REQUEST SENSE command.)

In addition to the exceptions associated with reading or writing data to the Viper drive (see Read and Write commands, as appropriate), the following exceptions may be reported for the COPY command:

- The Viper buffer size (Disconnect Size) configured by jumpers on the rear assembly is less than 8K. --

  CHECK CONDITION status is returned. Extended sense Key is set to ILLEGAL REQUEST.

- In a Segment Descriptor, the Logical Unit Number (LUN) for the managing Viper is not zero. --

  CHECK CONDITION status is returned. Extended sense Key is set to ILLEGAL REQUEST and Segment Number contains number of the descriptor that failed. (The first Segment Descriptor in the COPY Parameter List is number 0.)

- In a Segment Descriptor, an odd Number of Blocks was specified and the block size is 256. --

  CHECK CONDITION status is returned. Extended sense Key is set to ILLEGAL REQUEST. (It is also the case that the Viper will not permit disconnects for block size 256.)

- A Selection Timeout (250 ms.) occurred when the Viper attempted to the select the remote device. --

  CHECK CONDITION status is returned. Extended sense Key is set to ABORT COMMAND.

- A MODE SENSE response indicates the remote Direct Access device utilizes an unsupported blocksize. --

  CHECK CONDITION status is returned. Extended sense Key is set to ABORT COMMAND.

ERASE (Op Code = 19H)

The ERASE command causes all of the tape to be erased.

The tape must be positioned at beginning-of-medium (BOM) when the command is issued or the command will be rejected.

Upon completion of the operation, the tape will be repositioned to BOM.

=Byte=	7	6	5	4	3	2	1	0
0	0	0	0	1	1	0	0	1
1	0	0	0	0	0	0	0	1
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	X	X	0	0	0	0	Flag	Link

Byte 1, bit 0 (the Long bit) specifies that the entire tape is to be erased. This bit must be set to one. Viper does not support the short erase option.

Exception handling:

- The tape was not positioned at BOM when command was issued. --

  CHECK CONDITION status is returned. Extended sense Key is set to ILLEGAL REQUEST.

- The CDB contained invalid values in pre-defined field(s). --

  CHECK CONDITION status is returned. Extended sense is set to ILLEGAL REQUEST.

INQUIRY (Op Code = 12H)

The INQUIRY command requests that Viper parameter information be returned.

=Byte=	7	6	5	4	3	2	1	0
0	0	0	0	1	0	0	1	0
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	Allocation Length							
5	X	X	0	0	0	0	Flag	Link

The Allocation Length specifies the number of bytes that the initiator has allocated for the response data. An Allocation Length of zero indicates that no data shall be transferred. (This is not considered an error.) When non-zero, Viper will transfer the number of bytes specified up to a maximum of 36 bytes.

If an INQUIRY command is received from an initiator with a pending UNIT ATTENTION condition (before Viper reports CHECK CONDITION status), Viper will perform the INQUIRY command and not clear the unit attention condition.

=Byte=	7	6	5	4	3	2	1	0
0	Peripheral Device Type							
1	RM(1)	Device Type Qualifier (0)						
2	0	0	ECMA Version (0)			ANSI Version (1)		
3	0	0	0	0	0	0	0	0
4	Additional Length (1FH)							
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8 ↕ 15	Vendor ID - MSB ↕ Vendor ID - LSB							
16 ↕ 31	Product ID - MSB ↕ Product ID - LSB							
32 ↕ 35	Product Revision Level - MSB ↕ Product Revision Level - LSB							

Inquiry Data Format

Peripheral Device Type value 1 indicates a sequential access device, value 7FH indicates logical unit not present. Logical unit not present will be reflected only in the case where a non-zero LUN was contained in the last IDENTIFY message sent by the initiator.

The RM bit setting indicates removable media.

The ECMA version indicates no claim to compliance with the European Manufacturers Computer Association.

The ANSI version indicates compliance with standard X3.131-1986.

Additional Length indicates that 31 bytes of additional INQUIRY parameters follow (beginning in byte 5). This value will not be modified in the case that the Allocation Length in the CDB is too small to accommodate the entire response.

The Vendor I.D. is eight bytes of ASCII data: "ARCHIVE.b "[1]

The Product I.D. is sixteen bytes of ASCII data:

"VIPER 150 21247" for the Viper model 2150S.
"VIPER 60b 21116" for the Viper model 2060S.

The Product Revision Level is four bytes of ASCII data: "-xxx"

where xxx is the 3-digit revision number; for example: "-602".

[1] b = space.

LOAD/UNLOAD (Op Code = 1BH)

The LOAD/UNLOAD command requests that Viper enable or disable the logical unit for further operations. In both operations, the tape is positioned to BOM before loading/ unloading.

=Byte=	7	6	5	4	3	2	1	0
0	0	0	0	1	1	0	1	1
1	0	0	0	0	0	0	0	IMMED
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	RETEN	Load
5	X	X	0	0	0	0	Flag	Link

The IMMED (immediate) bit specifies that status is to be returned as soon as the operation is initiated. When this bit is zero, status will not be returned until the medium is positioned.

The Load bit specifies whether the medium is to be loaded or unloaded; value one indicates to load, value zero to unload.

The RETEN (re-tension) bit specifies that the medium is to be correctly tensioned before the LOAD/UNLOAD command is completed.

Exception handling:

- Both the IMMED bit and the Link bit were set to one. --

  CHECK CONDITION status is returned. Extended sense is set to ILLEGAL REQUEST.

- The CDB contained invalid values in pre-defined field(s). --

  CHECK CONDITION status is returned. Extended sense is set to ILLEGAL REQUEST.

MODE SELECT (Op Code = 15H)

The MODE SELECT command is used to enable/disable Viper internal buffering and (for Model 2150S only) to change the tape format mode.

=Byte=	7	6	5	4	3	2	1	0
0	0	0	0	1	0	1	0	1
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	Parameter List Length							
5	X	X	0	0	0	0	Flag	Link

Parameter List Length designates the number of bytes in the trailing parameter list.

=Byte=	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
2	0	Buffer Mode			Speed (0)			
3	Block Descriptor Length							

Mode Select Header

The Block Descriptor Length contains the number of bytes in all Block Descriptors that may trail the Header.

Viper interprets the 3-bit Buffer Mode field as follows.

BUFFER MODE	INTERPRETATION
0	Unbuffered
1	Buffered
2-7	Invalid

In buffered mode, Viper will report GOOD status on WRITE commands as soon as the blocks to be written have been transferred to the Viper's internal buffer. In unbuffered mode, the Viper will not report GOOD status until the blocks have been written successfully to tape.

=Byte=	7	6	5	4	3	2	1	0
0	Density Code							
1	Number of Blocks - MSB (0)							
2	Number of Blocks ------ (0)							
3	Number of Blocks - LSB (0)							
4	0	0	0	0	0	0	0	0
5	Block Length - MSB (0)							
6	Block Length ----- (2)							
7	Block Length - LSB (0)							

Block Descriptors

Viper interprets the 8-bit Density Code field (for Model 2150S only) as follows.

DENSITY CODE	INTERPRETATION
00h	Default mode **
05h	QIC-24
0Fh	QIC-120
10h	QIC-150

** In default mode, Viper performs format determination during read operations, then automatically adapts the format in which the data was recorded. Also in default mode, Viper performs cartridge type determination during write operations, then automatically selects format QIC-150 for DC600XTD cartridges or QIC-120 for DC600A cartridges.

Exception handling:

- The Parameter List contained an invalid Buffer Mode or Tape Format Mode value. --

  The command is rejected as follows. CHECK CONDITION is returned. Extended sense Key is set to ILLEGAL REQUEST.

- The CDB Parameter List Length was zero. --

  No data is transferred. (This is not considered an error.)

- The CDB contained invalid values in pre-defined field(s). --

  CHECK CONDITION status is returned. Extended sense is set to ILLEGAL REQUEST.

MODE SENSE (Op Code = 1AH)

The MODE SENSE command provides a means for Viper to report its current mode settings to the initiator.

=Byte=	7	6	5	4	3	2	1	0
0	0	0	0	1	1	0	1	0
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	Allocation Length							
5	X	X	0	0	0	0	Flag	Link

Allocation Length specifies the number of bytes the initiator has reserved for the response. An Allocation Length of zero indicates that no bytes of response will be transferred. When non-zero, the number of bytes specified in Allocation Length will be transferred up to a maximum of 12 bytes.

The MODE SENSE response data consists of a four-byte header followed by an eight-byte list of Block Descriptors.

=Byte=	7	6	5	4	3	2	1	0
0	Sense Data Length (8)							
1	Medium Type (0)							
2	WP	Buffer Mode			Speed (0)			
3	Block Descriptor Length (0)							

Mode Sense Header

Sense Data Length specifies the number of bytes of sense information that follow the Sense Data Length byte itself.

Medium Type will always be zero.

The WP bit indicates whether or not the tape is write protected; value one indicates write protected, value zero indicates write enabled.

The 3-bit Buffer Mode field indicates whether or not the Viper is in buffered mode; value one indicates buffered; value zero indicates unbuffered. (See MODE SELECT command description for an explanation of buffering modes.)

The 4-bit Speed field will always be set to zero, representing the single default speed supported by Viper

Block Descriptor Length specifies the number of bytes in the trailing list of Block Descriptors. It will normally be set to 0 or 8.

=Byte=	7	6	5	4	3	2	1	0
0	Density Code							
1	Number of Blocks - MSB (0)							
2	Number of Blocks ----- (0)							
3	Number of Blocks - LSB (0)							
4	0	0	0	0	0	0	0	0
5	Block Length - MSB (0)							
6	Block Length ----- (2)							
7	Block Length - LSB (0)							

Block Descriptors

The Density codes are defined as follows:

MODEL	CODE	DENSITY
2150S	10h	18 track (read/write)
"	0Fh	15 track (read/write)
"	05h	9 track (read only)
2060S	05h	9 track (read/write)

The 3-byte Number of Blocks field will be zero indicating that all logical blocks have the characteristics (density and block length) specified in this list of block descriptors.

The 3-byte Block Length field will be 512 indicating the fixed-size block length of 512 bytes.

Exception handling:

- The CDB contained invalid values in pre-defined field(s). --

  CHECK CONDITION status is returned. Extended sense is set to ILLEGAL

PREVENT/ALLOW MEDIA REMOVAL (Op Code = 1EH)

The PREVENT/ALLOW MEDIUM REMOVAL command requests that Viper turn on or turn off the front panel LED. The "on" condition would indicate to the user that the cartridge should not be removed.

The LED enabled condition is also terminated by receipt of a BUS DEVICE RESET message from any initiator or by a "hard" RESET condition.

=Byte=	7	6	5	4	3	2	1	0
0	0	0	0	1	1	1	1	0
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	PRVNT
5	X	X	0	0	0	0	Flag	Link

The PRVNT (prevent) bit specifies whether the front panel LED should be turned on (value one) or turned off (value zero).

Exception handling:

- The CDB contained invalid values in pre-defined field(s). --

  CHECK CONDITION status is returned. Extended sense is set to ILLEGAL REQUEST.

READ (Op Code = 08H)

The READ command transfers one or more data blocks to the initiator beginning with the next block on the tape.

Only fixed-length blocks (512 bytes per block) are supported.

Upon termination of a successful READ command, the tape is positioned after the last block transferred (EOM side).

=Byte=	7	6	5	4	3	2	1	0
0	0	0	0	0	1	0	0	0
1	0	0	0	0	0	0	0	1
2	Transfer Length - MSB							
3	Transfer Length							
4	Transfer Length - LSB							
5	X	X	0	0	0	0	Flag	Link

Byte 1, bit 0 (the Fixed Block Size bit) must be one, indicating blocks are fixed-size.

Transfer Length specifies the number of blocks to be read.

Exception handling:

- File Mark encountered during READ operation. --

  CHECK CONDITION status is returned. Extended sense FM bit is set. Extended sense Valid bit is set, indicating that the Residual Length is non-zero. Residual Length is set equal to the difference between the requested transfer length and the actual number of blocks read (File Mark not included). Upon termination, the tape is positioned after the File Mark (EOM side).

- READ was issued after last block on the tape had been read, and before physical end-of-tape. --

  CHECK CONDITION status is returned. Extended sense Key is set to BLANK CHECK to indicate that a no-data-detected condition was encountered.

- Physical end-of-tape encountered during READ operation. --

  CHECK CONDITION status is returned. Extended sense EOM bit is set. Extended sense Key is set to MEDIUM ERROR. Extended sense Valid bit is set to 1, indicating Residual Length is non-zero. Residual Length is set equal to the difference between the requested transfer length and the actual number of blocks read.

- An unreadable block was encountered during READ operation. --

  CHECK CONDITION status is returned. Extended sense Key is set to MEDIUM ERROR. The tape will be positioned after the block in error (EOM side). A subsequent READ command may be issued from this position.

- Transfer Length in READ CDB was zero. --

  No data is transferred and the current position of the tape is not changed. This exception condition is not considered an error.

- The CDB contained invalid values in pre-defined field(s). --

  CHECK CONDITION status is returned. Extended sense is set to ILLEGAL REQUEST.

READ BLOCK LIMITS (Op Code = 05H)

The READ BLOCK LIMITS command causes Viper to transfer the block length limits to the initiator. Both the maximum and minimum block lengths are set to 512, since Viper supports only one block length.

=Byte=	7	6	5	4	3	2	1	0
0	0	0	0	0	0	1	0	1
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	X	X	0	0	0	0	Flag	Link

There are no command dependent fields in the CDB.

=Byte=	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0
1	Maximum Block Length - MSB (00H)							
2	Maximum Block Length - - - - - (02H)							
3	Maximum Block Length - LSB (00H)							
4	Minimum Block Length - MSB (02H)							
5	Minimum Block Length - LSB (00H)							

Read Block Limits Data Format

The values of the individual bytes in the Block Length fields are shown above in hexadecimal notation.

Exception handling:

- The CDB contained invalid values in pre-defined field(s). --

  CHECK CONDITION status is returned. Extended sense is set to ILLEGAL REQUEST.

RECOVER BUFFERED DATA (Op Code = 14H)

The RECOVER BUFFERED DATA command is used to read data that has been transferred to the Viper buffer but has not been written on the medium. It is normally used only to recover from error conditions that make it impossible to write on the tape.

This command functions similarly to the READ command except that the data originates from the Viper buffer instead of from the medium.

Blocks are transferred in the same order as they would have been written to the tape. One or more RECOVER BUFFERED DATA commands may be used to read the unwritten buffered data.

=Byte=	7	6	5	4	3	2	1	0
0	0	0	0	1	0	1	0	0
1	0	0	0	0	0	0	0	1
2	Transfer Length - MSB							
3	Transfer Length							
4	Transfer Length - LSB							
5	X	X	0	0	0	0	Flag	Link

Byte 1, bit 0 (the Fixed Block Size bit) must be one, indicating blocks are fixed-size.

The Transfer Length specifies the number of contiguous blocks to be recovered.

Exception handling:

- The number of blocks specified in the Transfer Length exceeds the number of blocks remaining in the Viper buffer. --

  CHECK CONDITION status is returned. Extended sense EOM bit is set. Extended sense Valid bit is set, indicating the Residual Length is non-zero. Residual Length equals the difference between the requested Transfer Length and the actual number of blocks transferred.

- A Transfer Length of zero was specified. --

  No data is transferred. (This condition is not be considered an error.)

- The Fixed bit was not set. --

  The command is rejected as follows. CHECK CONDITION status is returned. Extended sense Key is set to ILLEGAL REQUEST.

- The CDB contained invalid values in pre-defined field(s). --

  CHECK CONDITION status is returned. Extended sense is set to ILLEGAL REQUEST.

RELEASE UNIT (Op Code = 17H)

The RELEASE UNIT command will release the current Viper reservation if the command is received from the initiator that originally established the reservation.

If the original reservation was made for a third party, the release CDB must also carry the third party data.

Any RELEASE UNIT command that arrives from other than the originating requestor (including one that arrives from the third party currently in command of the Viper) is ignored and GOOD status is returned in response to the command.

Additional events and conditions that can cause a reservation to be released are discussed under the RESERVE UNIT command.

=Byte=	7	6	5	4	3	2	1	0
0	0	0	0	1	0	1	1	1
1	0	0	0	3rdPty	3rd Party ID			0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	X	X	0	0	0	0	Flag	Link

The 3rdPty bit is used to indicate the release is for a third-party.

3rd Party ID specifies which initiator the release is for. It is meaningful only when the 3rdPty bit is set. Viper will not release a third party reservation if this field does not identify the initiator currently in control of the Viper.

Exception handling:

- The CDB contained invalid values in pre-defined field(s).—

  CHECK CONDITION status is returned. Extended sense is set to ILLEGAL REQUEST.

REQUEST BLOCK ADDRESS (Op Code = 02H)

The REQUEST BLOCK ADDRESS command requests Viper to transfer the current data block address to the initiator.

=Byte=	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	1	0
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	Allocation Length							
5	X	X	0	0	0	0	Flag	Link

An Allocation Length of zero indicates the command's default data transfer length is to be used. When non-zero, the number of bytes specified in Allocation Length (up to a maximum of 3 bytes) will be transferred.

=Byte=	7	6	5	4	3	2	1	0
0	0	0	0	0	Block Address - MSB			
1	Block Address							
2	Block Address - LSB							

Request Block Address Data Format

Block addresses begin with block number 1.

Exception handling:

- The CDB contained invalid values in pre-defined field(s). --

  CHECK CONDITION status is returned. Extended sense is set to ILLEGAL REQUEST.

REQUEST SENSE (Op Code = 03H)

The REQUEST SENSE command causes Viper to transfer sense data to the initiator.

The Viper returns extended sense format only.

The sense data will be valid for a CHECK CONDITION status returned on the prior command. Viper preserves sense data associated with a CHECK CONDITION status indefinitely until receipt of any subsequent command on the logical path on which the CHECK CONDITION status issued. In the case of the single initiator option, Viper will assume that the REQUEST SENSE command is from the same initiator.

The REQUEST SENSE command returns CHECK CONDITION status only if a fatal error occurs during execution of the REQUEST SENSE command itself. If non-fatal errors occur during REQUEST SENSE execution, GOOD status is returned. Following a fatal error on a REQUEST SENSE command, sense data may be invalid.

=Byte=	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	1	1
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	Allocation Length							
5	X	X	0	0	0	0	Flag	Link

When Allocation Length is zero, the Viper will transfer only 4 bytes of sense data; otherwise, all applicable bytes of Extended Sense Data will be transferred (up to the maximum Allocation Length).

=Byte	7	6	5	4	3	2	1	0
0	Valid	Class (7)			Error Code (0)			
1	Segment Number							
2	FM	EOM	ILI(0)	0	Sense Key			
3	Residual Length - MSB (0)							
4	Residual Length - - - - (0)							
5	Residual Length - - - - (0)							
6	Residual Length - LSB (0)							
7	Additional Sense Length							
8	COPY Source Sense Data Pointer							
9	COPY Destination Sense Data Pointer							
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
12	Number of Recoverable Errors - MSB							
13	Number of Recoverable Errors - LSB							
14	COPY Target Status							
15-22	COPY Target Sense Data (Bytes 0 - 7)							

Extended Sense Data Format

Class 7 indicates extended sense. Error Code 0 indicates the standard extended sense data format.

Segment Number is zero except when reporting a COPY exception. For COPY, Segment Number has a value from 0-255, referencing a specific Segment Descriptor from the Copy Parameter List.

The Valid bit indicates whether or not the Residual Length field is defined; if set to one, Residual Length is the difference of the requested length minus the actual length in blocks.

The FM bit indicates the current command has encountered a File Mark.

The EOM bit indicates that:

1) early-warning end-of-tape has been reached or passed in the forward direction, or

2) the command could not be completed because beginning-of-tape (BOT) was encountered in the reverse direction.

The Incorrect Length Indicator (ILI) is not applicable since variable block length selection is not supported.

The Sense Key indicates the type of event that caused the CHECK CONDITION. Because ANSI X3.131 makes no provisions for multiple error reporting, a Viper priority code has been assigned to each of the possible Sense Keys. In the case of multiple errors, the Sense Key with highest priority will be reported. The priorities are numbered one through eleven, with one being the highest priority. (Refer to Table of Sense Keys.)

Additional Sense Length contains the number of bytes after Byte 7.

Number of Recoverable Errors is a 16-bit soft error count that accumulated over a series of commands. The value in this field is reset to zero when the direction of data transfer changes with respect to the tape.

The following fields are used only for reporting COPY command exceptions.

The COPY Source Sense Data Pointer will contain 14 (the byte offset to the COPY Target Status field) if the exception emanated from the source device; otherwise it will contain zero.

The COPY Destination Sense Data Pointer will contain 14 if the exception emanated from the destination device; otherwise it will contain zero.

When present, COPY Target Status contains the Status byte for the remote device, which may be either the source or destination device.

When present, COPY Target Sense Data contains sense information (bytes 0 through 7 of Extended Sense format) for the target device. This information may be provided when Sense Key is set to COPY ABORT or ABORT COMMAND.

Exception handling:

- An unrecoverable parity error on the data bus or other malfunction prevents transfer of the sense data to the initiator. --

  CHECK CONDITION status is returned. Extended sense is not updated.

- The CDB contained invalid values in pre-defined field(s). --

  CHECK CONDITION status is returned. Extended sense is set to ILLEGAL REQUEST.

KEY	PRIORITY	DEFINITION
00H	11	NO SENSE - The CHECK CONDITION occurred in conjunction with detection of FM or EOM or status was not available.
01H	10	RECOVERED ERROR - The last command completed successfully following recovery actions by Viper. A CHECK CONDITION was not issued.
02H	8	NOT READY - The Viper cannot be accessed. Operator intervention may be required to correct this condition.
03H	3	MEDIUM ERROR - The command terminated with a non-recoverable error that was probably caused by a flaw in the medium or an error in the recorded data.
04H	2	HARDWARE ERROR - The Viper detected a non-recoverable hardware failure (parity, etc.) while performing the command.
05H	7	ILLEGAL REQUEST - The Command Descriptor Block contained an illegal parameter.
06H	1	UNIT ATTENTION - The cartridge has been changed or the Viper has been reset.
07H	9	DATA PROTECT - The cartridge is write-protected (SAFE). The operation was not performed.
08H	6	BLANK CHECK - A no-data condition was encountered on the tape.
09H	n/a	VENDOR UNIQUE - Not used.
0BH	4	ABORTED COMMAND - The Viper aborted the command. The initiator may be able to recover by trying the command again.
0DH	5	VOLUME OVERFLOW - The Viper has reached the physical end-of-medium and data remains in the buffer that has not been written to the tape. A RECOVER BUFFERED DATA command(s) may be issued to read unwritten data from the buffer.

Table of Sense Keys

RESERVE UNIT (Op Code = 16H)

The RESERVE UNIT command will reserve the Viper for the exclusive use of the requesting initiator or for the exclusive use of another (third party) specified SCSI device.

The third party reservation option is provided for multi-initiator systems that use the COPY command.

Viper reservation, once established, will remain in effect until one of the following:

- Another RESERVE UNIT command arrives from the same initiator that requested the current reservation (for itself or for a third party). The new reservation will supersede the current one. The new reservation may be the same as the current one. Redundant use of the command is not considered an error.
- A RELEASE UNIT command arrives from the same initiator that requested the current reservation. The Viper will return to un-reserved mode.
- A BUS DEVICE RESET message arrives from any initiator.
- A "hard" RESET condition occurs.

When the Viper is reserved, it returns RESERVATION CONFLICT status in response to any and all commands received from excluded initiators except in response to the RELEASE UNIT command (processing varies--see RELEASE UNIT command) and except in response to a subsequent RESERVE UNIT command from the original reservation requestor (discussed above).

=Byte=	7	6	5	4	3	2	1	0
0	0	0	0	1	0	1	1	0
1	0	0	0	3rdPty	3rd Party ID			0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	X	X	0	0	0	0	Flag	Link

The 3rdPty bit is used to indicate whether or not the reservation is for a third party.

3rd Party I.D. specifies the third party initiator. This field is meaningful only if the 3rdPty bit is set to one.

Exception handling:

- A BUS DEVICE RESET message arrives from any initiator. —

  Occurrence of this event will be indicated on the next command following the event as follows: CHECK CONDITION status is returned. Extended sense Key is set to UNIT ATTENTION.

- A "hard" RESET condition is detected. —

  Occurrence of this event will be indicated on the next command following the event as follows: CHECK CONDITION status is returned. Extended sense Key is set to UNIT ATTENTION.

- The CDB contained invalid values in pre-defined field(s). —

  CHECK CONDITION status is returned. Extended sense is set to ILLEGAL REQUEST.

REWIND (Op Code = 01H)

The REWIND command causes Viper to rewind to the beginning-of-tape.

=Byte=	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	1
1	0	0	0	0	0	0	0	IMMED
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	X	X	0	0	0	0	Flag	Link

The IMMED (immediate) bit can be used to specify that status be returned as soon as the operation is initiated.

Exception handling:

- Both the IMMED bit and the Link bit were set. --

  CHECK CONDITION status is returned. Extended sense Key is set to ILLEGAL REQUEST.

- The CDB contained invalid values in pre-defined field(s). --

  CHECK CONDITION status is returned. Extended sense is set to ILLEGAL REQUEST.

SEEK BLOCK (Op Code = 0CH)

The SEEK BLOCK command causes Viper to position the tape at the specified block address. No data is transferred.

The initiator may obtain block addresses via the REQUEST BLOCK ADDRESS command as part of its tape write procedures. The block addresses can, in turn, be recorded in a user-defined directory. Typically, this directory is located at the end-of-recorded-data and is used to rapidly position at the beginning of specific files on the tape. (Refer to SPACE command for information on user-defined directory support.)

=Byte=	7	6	5	4	3	2	1	0
0	0	0	0	0	1	1	0	0
1	0	0	0	0	0	0	0	IMMED
2	0	0	0	0	Block Address - MSB			
3	Block Address							
4	Block Address - LSB							
5	X	X	0	0	0	0	Flag	Link

The IMMED (immediate) bit is used to request that status be returned as soon as the operation is initiated. When the IMMED bit is not set, status will be returned after the tape is positioned at the specified block.

Exception handling:

- Specified block not found on tape. --

  CHECK CONDITION status is returned. Extended sense Key is set to BLANK CHECK. The tape position following this condition is undetermined.

- Block Address in CDB was zero. --

  CHECK CONDITION status is returned. Extended sense Key is set to ILLEGAL REQUEST. (Viper block addresses begin with number 1.)

- Both Link bit and IMMED bit in CDB were set. --

CHECK CONDITION status is returned. Extended sense Key is set to ILLEGAL REQUEST.

- The CDB contained invalid values in pre-defined field(s). --

  CHECK CONDITION status is returned. Extended sense is set to ILLEGAL REQUEST.

SEND DIAGNOSTIC (Op Code 1DH)

The SEND DIAGNOSTIC command causes Viper to perform diagnostic self-tests on its buffer memory. The tests are part of Viper's resident firmware. No data is transferred between the Viper and the initiator during this command.

GOOD status is returned if the tests ran successfully.

=Byte=	7	6	5	4	3	2	1	0
0	0	0	0	1	1	1	0	1
1	0	0	0	0	0	1	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	X	X	0	0	0	0	Flag	Link

Byte 1, bit 2 (the SelfTest bit) must be set to one, indicating Viper is to perform its self-test procedures and that a parameter list will not be utilized.

Byte 1, bits 0-1 (the UnitOfl and DevOfl bits) must be set to zero. They are inapplicable since the Viper self-test does not utilize the medium during testing.

Bytes 3-4 (the Parameter List Length) must be set to zero. They are inapplicable as per the setting of the SelfTest bit.

Exception handling:

- A test failure occurred. --

  CHECK CONDITION status is returned. Extended sense Key is set to HARDWARE ERROR.

- The CDB contained invalid values in pre-defined field(s). --

  CHECK CONDITION status is returned. Extended sense is set to ILLEGAL REQUEST.

SPACE (Op Code = 11H)

The SPACE command moves the tape:

forward or backward a specified number of blocks
forward or backward a specified number of File Marks
forward or backward a specified number of sequential (contiguously grouped) File Marks
forward to the end-of-recorded-data.

The difference between the two File Mark functions is that one (SPACE File Marks) counts individual marks and the other (SPACE Sequential File Marks) searches for the first set of contiguous File Marks.

=Byte=	7	6	5	4	3	2	1	0
0	0	0	0	1	0	0	0	1
1	0	0	0	0	0	0	Code	
2	Count - MSB							
3	Count							
4	Count - LSB							
5	X	X	0	0	0	0	Flag	Link

The Code field designates the desired function as follows.

CODE	TYPE	FUNCTION
0	C	SPACE blocks
1	C	SPACE File Marks
2	C	SPACE Sequential File Marks
3	S	SPACE to end-of-recorded-data

Type C (space-by-count) functions:

The Count field indicates both direction (forward or reverse) and distance (the number of blocks/File Marks to be spaced over). A positive value N in the Count field causes forward tape movement over N blocks or File Marks (or sets of contiguous File Marks in the case of SPACE sequential). A negative value -N (2's complement notation) in the Count field causes reverse tape movement over N blocks or File Marks (or sets of File Marks). A zero value in the count field causes no tape movement.

When there are no exception conditions during the space-by-count functions, forward movement of the tape ends on the EOM side of the last block or File Mark and reverse movement ends on the BOM side of the last block or File Mark.

Type S (space specific position) functions:

The Count field is non-applicable.

In the SPACE to end-of-recorded-data function, the tape is positioned such that a subsequent WRITE command will append data to the last recorded information on the tape.

The SPACE to end-of-recorded-data function is useful in support of user-defined directories containing the starting block addresses of individual data files on the tape. When the directory file is always written (re-written) after the last file on tape, the SPACE command can be used to rapidly locate it again. To locate the first block of the directory, the user spaces to EOD, then spaces reverse one File Mark (which positions to BOM side of the mark) and then spaces forward one File Mark. Note that there are differing techniques for defining the location of directories on tape, and that in the case where the directory is always to trail the last file it is the user's responsibility to insure the directory information is not lost when the preceding data files are expanded. One method of doing this is to read and preserve the entire directory in memory during the tape update process and then write it back to tape when the process concludes.

Type C exception handling:

- File Mark encountered while spacing over blocks. --

  CHECK CONDITION status is returned. Extended sense FM bit is set. Extended sense Valid bit is set, indicating Residual Length is non-zero. The Residual Length equals the difference in the requested count and the actual number of blocks spaced over (not including the File Mark). The tape is positioned on the EOM side of the File Mark if movement was in the forward direction or on the BOM side of the File Mark if movement was in the reverse direction.

- End-of-recorded-data is encountered while spacing forward over blocks or File Marks. --

  CHECK CONDITION status is returned. Extended sense Key is set to BLANK CHECK. Extended sense Key is set to BLANK CHECK. Extended sense Valid bit is set, indicating Residual Length is non-zero. The Residual Length equals the difference between the requested count and the actual number of blocks or File Marks spaced over.

- Beginning-of-medium is encountered while spacing in reverse over blocks or File Marks. --

  CHECK CONDITION status is returned. Extended sense EOM bit is set. Extended sense Key is set to NO SENSE. Extended sense Valid bit is set, indicating Residual Length is non-zero. The Residual Length equals the difference between the requested count and the actual number of blocks and/or File Marks spaced over.

- Physical end-of-tape is encountered while spacing forward over blocks, File Marks. --

  CHECK CONDITION status is returned. Extended sense EOM bit is set. Extended sense Key is set to MEDIUM ERROR. Extended sense Valid bit is set, indicating Residual Length is non-zero. The Residual Length equals the difference between the requested count and the actual number of blocks and/or File Marks spaced over. When spacing over sequential File Marks, Residual Length equals the requested count.

- Unrecoverable data error is encountered. --

  CHECK CONDITION status is returned. Extended sense Key is set to MEDIUM ERROR. Extended sense Valid bit is set, indicating Residual Length is non-zero. The Residual Length equals the difference between the requested count and the actual number of blocks and/or File Marks spaced over.

- The CDB contained invalid values in pre-defined field(s). --

  CHECK CONDITION status is returned. Extended sense is set to ILLEGAL REQUEST.

Type S exception handling:

- Physical end-of-tape is encountered while spacing to EOD. --

  CHECK CONDITION status is returned. Extended sense is set to MEDIUM ERROR.

- The CDB contained invalid values in pre-defined field(s). --

  CHECK CONDITION status is returned. Extended sense is set to ILLEGAL REQUEST

TEST UNIT READY (Op Code = 00H)

The TEST UNIT READY command provides a means to determine if the Viper is ready to accept a medium access command. If so, the Viper returns GOOD status.

=Byte=	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	X	X	0	0	0	0	Flag	Link

Exception handling:

- The CDB contained invalid values in pre-defined field(s). --

  CHECK CONDITION status is returned. Extended sense is set to ILLEGAL REQUEST.

VERIFY (Op Code = 13H)

The VERIFY command verifies one or more block(s) beginning with the next block on the logical unit.

The Viper VERIFY command verifies the Cyclic Redundancy Checks (CRCs) on the medium and does not support byte-by-byte comparison of tape data with initiator-supplied data. No data is transferred between the initiator and Viper during the verify operation and no data is written to the medium.

The command terminates after the specified number of blocks have been verified or when Viper encounters a File Mark, the EOM condition, or an unrecoverable error (including an invalid CRC).

Upon completion the medium is positioned after the last block verified or after the File Mark (if one were encountered).

=Byte=	7	6	5	4	3	2	1	0
0	0	0	0	1	0	0	1	1
1	0	0	0	0	0	0	0	1
2	Verify Length - MSB							
3	Verify Length							
4	Verify Length - LSB							
5	X	X	0	0	0	0	Flag	Link

Byte 1, bit 1 (the Byte Compare bit) must be zero, indicating CRC verification is requested. The byte comparison option is not supported.

Byte 1, bit 0 (the Fixed Block Size bit) must be one, indicating blocks are fixed-size. The variable length block option is not supported.

The Verify Length specifies the number of contiguous blocks to be verified.

Exception handling:

- A File Mark, EOM or unrecoverable error was encountered. --

  Status and sense data for each of these conditions are handled the same as for the READ command.

- The VERIFY CDB Verification Length was zero. --

  No data will be verified and the current position on the tape will not be changed. (This condition is not considered an error.)

- The CDB contained invalid values in pre-defined field(s). --

  CHECK CONDITION status is returned. Extended sense is set to ILLEGAL REQUEST.

WRITE (Op Code = 0AH)

The WRITE command transfers one or more data blocks from the initiator to Viper. Only fixed length blocks (512 bytes per block) are supported.

Upon termination, the tape will be positioned after the last block written (EOM side).

=Byte=	7	6	5	4	3	2	1	0
0	0	0	0	0	1	0	1	0
1	0	0	0	0	0	0	0	1
2	Transfer Length - MSB							
3	Transfer Length							
4	Transfer Length - LSB							
5	X	X	0	0	0	0	Flag	Link

Byte 1, bit 0 (the Fixed Size bit) must be one, indicating blocks are fixed-size.

Transfer Length specifies the number of blocks to be written beginning at the current tape position.

Exception handling:

- Early warning EOM encountered during WRITE operation. --

  An attempt to finish writing any buffered data will be made. CHECK CONDITION status is returned. Extended sense EOM bit is set.If no data remains in the buffer, extended sense Key is set to NO SENSE. If any data remains in the buffer, extended sense Key is set to VOLUME OVERFLOW and the Valid bit is set, indicating Residual Length is non-zero.The value in Residual Length depends on whether or not Viper is in buffered mode (see MODE SELECT command). In non-buffered mode, Residual Length equals the difference between the requested transfer length and the actual number of blocks written to tape. In buffered mode, Residual Length equals the total number of unwritten blocks (the number of blocks not transferred from the initiator plus the number of blocks remaining in the Viper buffer). Note that in this case it is possible for Residual Length to exceed the Transfer Length.

- Another WRITE command was issued after early warning EOM had been reported. --

  As long as physical end-of-tape is not encountered, the Viper will continue to complete write operations to the tape. The initiator is permitted to write beyond the early warning EOM. Extended sense EOM is set for all WRITES that proceed beyond EOM but the CHECK CONDITION status is not repeated for each subsequent operation. (See note on early warning EOM below.)

- End-of-tape encountered during WRITE operation. --

  CHECK CONDITION status is returned. Extended sense EOM bit is set. Extended sense Key is set to MEDIUM ERROR. The settings of the extended sense Valid bit and Residual Length are determined as for the early warning EOM condition.

- Transfer Length in WRITE CDB was zero. --

  No data is transferred and the current position of the tape is not changed. This exception condition is not considered an error.

- The CDB contained invalid values in pre-defined field(s). --

  CHECK CONDITION status is returned. Extended sense is set to ILLEGAL REQUEST.

NOTE: The EOM condition on the Viper is a logical end-of-medium which does not coincide with the physical end-of-tape. The EOM indication will occur at approximately 1 Mbyte, (i.e. 2048 blocks) before physical EOM.

WRITE FILEMARKS (Op Code = 10H)

The WRITE FILEMARKS command causes the specified number of File Marks to be written to tape beginning at the current block position or, in the case where buffered data remains to be written, following the last buffered data block.

This command can be used to force all remaining buffered data blocks to be written to tape without appending File Marks by specifying zero File Marks.

The command will not return GOOD status to the initiator unless all buffered data blocks and File Marks (if any) were written correctly on the tape.

=Byte=	7	6	5	4	3	2	1	0
0	0	0	0	1	0	0	0	0
1	0	0	0	0	0	0	0	0
2	Number of File Marks - MSB							
3	Number of File Marks							
4	Number of File Marks - LSB							
5	X	X	0	0	0	0	Flag	Link

Exception handling:

- Early warning end-of-medium encountered during WRITE FILEMARKS operation. --

  An attempt to finish writing any buffered data will be made. CHECK CONDITION status is returned. Extended sense EOM bit is set.If no data remains in the buffer and the specified number of File Marks have been written, extended sense Key is set to NO SENSE. If any File Marks (and possibly data) remain to be written, extended sense Key is set to VOLUME OVERFLOW and the Valid bit is set, indicating Residual Length is non-zero.The value in Residual Length depends on whether or not Viper is in buffered mode (see MODE SELECT command). In non-buffered mode, Residual Length equals the number of unwritten File Marks. In buffered mode, Residual Length equals the total number of unwritten blocks (the number of blocks remaining in the Viper buffer plus the number of unwritten File Marks). Note that in this case it is possible for Residual Length to exceed the Transfer Length.

- Another WRITE FILEMARKS command issued subsequent to a WRITE or WRITE FILEMARKS that encountered early warning EOM. --

  As long as physical end-of-tape is not encountered, the Viper will continue to attempt to write all data and File Marks onto the tape. The initiator is permitted to write beyond the early warning EOM. Extended sense EOM is set for all writes beyond early warning EOM. (See discussion on early warning end-of-medium under WRITE command.)

- End-of-tape encountered during WRITE FILEMARKS operation. --

  CHECK CONDITION status is returned. Extended sense EOM bit is set. Extended sense Key is set to MEDIUM ERROR. The settings of the extended sense Valid bit and Residual Length are determined as for the early warning EOM condition.

- The CDB contained invalid values in pre-defined field(s). --

  CHECK CONDITION status is returned. Extended sense is set to ILLEGAL REQUEST.

Chapter 7
RELIABILITY AND MAINTENANCE

RELIABILITY

Specifications

FEATURE	SPECIFICATION
Recoverable read error rate	Not more than 1 in 10^8 bits
Non-recoverable read error rate	Not more than 1 in 10^{10} bits
MTBF	15,000 hours or more
MTTR	Less than 30 minutes

Recoverable vs. Non-recoverable Errors

Tape errors encountered by the error-checking capabilities of the drive are classified as Recoverable Errors and Non-recoverable Errors.

A Recoverable Error (also known as a Soft Error) is a rewrite or a re-read attempt, performed under firmware control (and transparent to the user), when a marginal block of data is encountered. The drive controller initiates up to 16 attempts to rewrite or re-read the marginal data block. During rereads, the Off-track Stepping function may be invoked. If the data cannot be recovered after 16 attempts, a Non-recoverable Error (also known as a Hard Error) is declared and drive operation is stopped.

Rewrites are normal occurrences and are typically an indication of tape quality or drive cleanliness. An increase in rewrites or the recoverable error rate can indicate that the recording medium is deteriorating.

Mean-Time-Between-Failures

The Mean-Time-Between-Failures (MTBF) includes all power-on and operational time. Operational time (tape movement) is assumed to be 20% of the power-on time.

Mean-Time-To-Repair

The Mean-Time-To-Repair (MTTR) is the average time required by an Archive field engineer (or equivalent) to diagnose and repair a defective drive by replacing the drive.

PREVENTIVE MAINTENANCE

The only preventive maintenance required for the Viper is that the head and sensor holes must be kept clean. Since a very small amount of contamination can inhibit performance, a cleaning schedule should be established.

Recommended Cleaning Schedules:

Read/write/erase heads:

- The recording head should be cleaned after each initial pass with a new tape cartridge.
- The recording head should be cleaned after every 8 hours of read, write or erase activity.

Sensor openings and tape cartridge cavity:

- The sensor openings and cartridge cavity should be cleaned whenever dust or debris is visible inside the cartridge cavity.

Cleaning Supplies:

Part Numbers for Archive products are in Appendix A.

- An Archive streamer head cleaner kit.
- Low pressure air in an aerosol can.

Optional/spare:

- Archive streaming head cleaning fluid.
- Archive head cleaning pads.
- head-cleaning swabs (see note)

NOTE: If an Archive streamer head cleaner cassette is not available, the head may be cleaned using 6-inch long swabs made from lintless cotton or equivalent non-abrasive material, or any industry acceptable head-cleaning swabs, and Archive head-cleaning fluid or Freon-TF. Alcohol should not be used to clean the head.

Cleaning Procedure:

1. Visually inspect the interior of the drive. If contamination is visible in the sensor holes or within the cartridge cavity of the drive, carefully blow out visible dust or debris from these areas with low pressure air from the aerosol can.

2. Follow the instructions in the head-cleaner cassette kit and clean the head assembly.

3. If using swabs and head-cleaning fluid, perform the following steps:

   a. Turn OFF power to the drive.

   b. Slide the cartridge loading lever toward the cartridge insertion opening until the heads are extended into the cartridge cavity.

   c. Moisten the spade end of the swab with head-cleaning solution until it is saturated but not dripping.

   d. Carefully Wipe the swab across the head in the directions that the tape moves. Do not wipe the head in the direction perpendicular to tape movement as residue could collect in minute crevices of the head. Do not use a scrubbing, circular motion.

   e. Discard the first swab; moisten a second swab and repeat the wiping motion until all residue has been removed from the head surface.

   f. Discard the second swab. With a clean, dry swab, wipe the head using the same motions described in step d, until the head is clean and dry.

   g. Move the cartridge loading lever away from the cartridge insertion opening and return the head assembly to its position outside of the cartridge area.

   h. Turn the drive power ON.

Appendix A

ARCHIVE PART NUMBERS

The following Archive part numbers are utilized with Viper SCSI models 2060S and 2150S.

PART NUMBER	DESCRIPTION
21153-*xxx*	Tape drive model 2060S with factory-installed terminating resistors
21068-*xxx*	Tape drive model 2060S without terminating resistors
21251-*xxx*	Tape drive model 2150S with factory-installed terminating resistors
21249-*xxx*	Tape drive model 2150S without terminating resistors
18219-001	Terminating resistors (3 required)
15864-001	Jumper clips
20121-003	Tape cartridge DC600A (600 ft.)
21225-001	Tape cartridge DC300XL (450 ft.)
21199-001	Tape cartridge DC600XTD (600 ft.)
14916-001	Archive streamer head-cleaner kit
14917-001	Archive head-cleaning fluid
14918-001	Archive head-cleaning pads

ARCHIVE®
CORPORATION

1650 Sunflower
Costa Mesa, CA 92626
(714) 641-0279 / Telex: 4722063